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14. ABSTRACT

Med-e-Tel, is an international conference and exhibition, taking place annually in Luxembourg and organized by Luxexpo. Med-e-Tel 2006 was held on April 5-7, 2006 and attracted 400 participants from 48 countries. Participants included hospital administrators and department heads, association executives, industry (health, IT, telecom) representatives, academia, researchers, local and international government representatives, health insurers, homecare services.
The Med-e-Tel 2006 conference program covered over 130 presentations on topics such as homecare and health management, healthcare challenges, tele-education, eHealth in developing countries, telecardiology, and more.
The Med-e-Tel 2006 exhibition showcased products and technologies in the areas of medication compliance, home telehealth and vital sign monitoring, clinical software, electronic medical records, results of telemedicine and ehealth projects, as well as information about some 40 publications, journals, reports and online information services in the fields of telemedicine and ehealth.
The Telemedicine and Advanced Technology Research Center (TATRC) presented a highly rated conference session on "Global Healthcare Challenges and Opportunities: The Role of Advanced Technology", covering the implementation of broadband networks, mobile solutions, operational standards, environmental sensors and telemedicine technologies.
Other organizations supporting and participating at Med-e-Tel 2006 included International Society for Telemedicine & eHealth (ISfTeH), World Health Organization (WHO), International Telecommunication Union (ITU), United Nations Office for Outer Space Affairs (UNOOSA), Information Society Directorate-General of the European Commission, Luxembourg Ministry of Health, European Health Telematics Association (EHTEL), uHealth initiative (part of IEEE Healthcom).

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Introduction

Med-e-Tel is a yearly event (conference and exhibition) aiming to bring together stakeholders in the fields of ehealth, telemedicine and health ICT. These stakeholders include industry representatives, hospital administrators and managers, hospital department heads, homecare service organizations, association executives, health insurers, military and government management (both at local/national and international level), academia and researchers.

Through conference programs, satellite symposia/workshops and an exhibition, information is provided on the latest developments in ehealth, telemedicine and health ICT, how to integrate these new developments into current medical practice, how they can improve clinical outcomes, how they promote widespread availability of medical services in underserved, remote areas and in developing countries, and what the legal and regulatory repercussions are.

Med-e-Tel enhances and stimulates interaction among users, providers, vendors (from the different industries that are involved: medical, IT and telecom + ancillary services), government, etc. Med-e-Tel 2006 proved once again that indeed one of the event's major strengths are exactly the networking opportunities that it provides and the opportunities to share information and experiences.

Body

The Med-e-Tel 2006 conference and exhibition, which took place on 5-7 April 2006 at Luxexpo, Luxembourg, focuses on the convergence of information and communication technologies (ICTs) with medical applications, which lead to higher quality of care, cost reductions, workflow efficiency, improved disease management and medication compliance, clinical decision support systems and widespread availability of healthcare services.

This growing evolution of using and implementing ICTs into healthcare practice does create a need for close cooperation and mutual understanding among medical professionals, IT specialists and telecom engineers about their respective needs and capabilities. This is exactly what Med-e-Tel is all about: bringing all parties together for the sake of learning from each other and sharing experiences. Med-e-Tel is a forum where offer (medical and ICT industry) and demand (healthcare professionals) can meet, together with researchers, policy makers and other stakeholders.

Med-e-Tel 2006 was host to 400 decision makers from 48 countries and featured a world class conference program, opening up windows to a multitude of ICT applications in the modern healthcare environment.

During the opening ceremony on April 5th, messages of welcome and introduction were delivered by:

- Alain Georges, Chairman of the Board, Luxexpo
- Mars Di Bartolomeo, Minister of Health, G.D. of Luxembourg
- Yunkap Kwankam, eHealth Coordinator, WHO
- Greg Mogel, Deputy Director, US Army Telemedicine and Advanced Technology Research Center

The program continued with the opening plenary conference session which presented and discussed some key activities and organizations that can be taken as reference points for the state of telemedicine and ehealth in the world today:

- the World Health Organization's (WHO) Global Observatory for eHealth, and the needs of the member states for ehealth tools and services, presented by Yunkap Kwankam, (eHealth Coordinator, WHO);
- the European eHealth action plan which is concentrating on making the most of health ICTs and a better integration of a range of ehealth policies and activities, presented by Illias Iakovidis (Deputy Head of Unit, ICT for Health, DG Information Society, European Commission);
- the Telemedicine Alliance's vision for ehealth implementation, presented by James Kass (European Space Agency);
- the role of the International Society for Telemedicine & eHealth (ISfTeH) in the advancement of telemedicine and ehealth through interaction and cooperation among national and international stakeholder groups and associations, presented by Frank Lievens (Board Member, ISfTeH);
- industry viewpoint on the relationship between public and private sector to develop sustainable ehealth programs, presented by Pramod Gaur (President & CEO, Viterion TeleHealthcare).

Extensive focus was placed throughout the conference on homecare and health/disease management, covering topics such as medication compliance, telemonitoring of vital signs, fall detection, video communication, and more. Home telehealth offers affordable and sometimes even necessary solutions to face the challenges of early hospital discharge, an increased ageing population and the associated rise in chronic conditions, and a predicted nursing shortage. Keeping patients-at-risk at home, or keeping the elderly living longer independently in their own home, will considerably relieve the current healthcare system and healthcare budgets.

On a related subject, the International Initiative for Ubiquitous Healthcare (uHealth), presented its views on how collaboration between countries and the use of broadband and wireless mobile technologies can help to provide healthcare to people anywhere at anytime.
The initiative was conceived as part of the future activities of IEEE Healthcom, which brings together academia, industry, healthcare and information technology professionals to facilitate collaborations for the development of humanity's future good.
According to the uHealth Initiative, the world's increasing ageing population necessitates concentrated research and action on healthcare paradigms beyond the current hospital-based healthcare regime because the hospitals (which are already stretched to limits) will not be able to handle the increase in ageing population.
Current partner countries in the initiative include Australia, France, Greece, Korea, Taiwan and USA, with more to join soon.

Aims and results of various current European ehealth projects were also presented. Among them, projects dealing with new generation telemedicine services for home care (Interlife), mobilization and accessibility planning for people with disabilities (Mapped), context-aware business application service coordination in mobile computing environments (Cascom), and support for healthcare professionals in reducing risk management in their daily practice by building knowledge driven & dynamically adaptive networked communities within European health care systems (Cocoon). Two projects even conducted full scale workshops at Med-e-Tel presenting their achievements so far and demonstrating pilot applications. The first one was Healthware, a standard and interoperable satellite solution to deploy healthcare services over wide areas. The second one was Doc@Hand, knowledge sharing and decision support for healthcare professionals.

The role of advanced technology in global healthcare challenges and opportunities was addressed by the Telemedicine and Advanced Technology Research Center (TATRC), a subordinate element of the United States Army Research and Material Command (USAMRMC). This session covered the implementation of broadband networks, mobile solutions, operational standards, environmental sensors and telemedicine technologies.

The Luxembourg CRP-Santé (Institute for Research in Healthcare, Public Health & Biotechnology) conducted a regional symposium at Med-e-Tel, focusing on how IT services at the patient's disposal will lead to new solutions and new strategies for hospitals, mutualities (healthcare insurance providers) and the industry. The symposium saw Luxembourg Minister of Health, Mars Di Bartolomeo, provide an overview of current realizations and future projects in this field. Several business cases, presented by industry leaders like IBM, Telindus and Selligent, illustrated successful applications in automated appointment booking, online consultation of electronic patient records, CRM, telemonitoring, RFID, mobile applications, electronic signatures, and health portals. The symposium showed how IT services change the way hospital departments and mutualities are run and how they interact with the outside world.

A returning topic at Med-e-Tel 2006 was the one of "eHealth for Developing Countries". eHealth is an important tool to cope with the specific healthcare problems that exist in the developing world (shortage of qualified doctors and specialists, AIDS/HIV pandemic, etc.). Previous Med-e-Tel editions already saw participants from El Salvador to Tanzania and from Zambia to Indonesia gaining a wealth of information at the event. The 2006 session attracted once again a large number of stakeholders from developing countries (a.o. Georgia, Moldova, Nigeria, Rwanda, South Africa) and was chaired by World Health Organization (WHO), International Telecommunication Union (ITU) and International Society for Telemedicine & eHealth (ISfTeH) representatives, who are all at the forefront of telemedicine and ehealth implementation in the developing world.
Also the role of satellite communication and space-based technology applications in healthcare, especially for developing countries and for remote and isolated areas, was explored in a session coordinated by the United Nations Office for Outer Space Affairs (UNOOSA), who also presented various posters on this subject at the Med-e-Tel exhibition, mainly from projects in Latin America.

The above conference sessions were complemented with various additional sessions on the topics of tele-education, disease surveillance, electronic records and data transmission, healthcare challenges, telecardiology and practical telemedicine and ehealth applications in several other medical disciplines.

The Med-e-Tel exhibition floor showcased medication compliance products, home telehealth and vital sign monitoring systems and services, clinical software packages, electronic medical records, results of telemedicine and ehealth projects, and much more.
Med-e-Tel 2006 also presented a media corner where information was provided about some 40 publications, books, magazines, journals, reports and online news and information services in the fields of telemedicine and ehealth.

In short, Med-e-Tel offered unique opportunities to discover products, services and innovative technologies, to gather updated information through the extensive conference programs, network with contacts from around the world, and establish new partnerships.

Key Research Accomplishments

Med-e-Tel 2006 participants indicated the following aspects to be among the key advantages and reasons to attend the event:

- extensive networking opportunities with a wide variety of ehealth/telemedicine players from many different countries;
- dissemination of information and current or recent research results, and sharing ideas and experiences;
- possibility to view and get acquainted with currently available devices, technologies and services through the exhibition;
- establishing (cross-industry) partnerships and cooperation.

A survey that was conducted on-site (n = 73), showed that:

- 92% of participants were satisfied with the event and expressed that the event met or exceeded their expectations;
- 94% plan follow-up actions as a result of their participation at Med-e-Tel;
- 94% will also recommend the event to others;
- 87% rated the contents of the conference programs good to excellent;
- 97% found the exchange of experiences and the networking opportunities to be satisfactory.

Some "free form" comments made clear that especially the contributions to the conference program made by the following organizations or on the following topics were highly acclaimed:

- Telemedicine and Advanced Technology Research Center (TATRC)
- World Health Organization (WHO)
- session on developing countries
- European Commission (Information Society Directorate-General)
- uHealth (Ubiquitous Healthcare) initiative, part of IEEE Healthcom
- International Telecommunication Union (ITU)
- European Space Agency (ESA)

Also personal contacts between the organizers and participants made clear that especially the TATRC Symposium was considered to be among the most interesting sessions of the Med-e-Tel 2006 event (valuable content, great speakers).

Actual conference program and exhibition contents are available in the Med-e-Tel 2006 Proceedings, Exhibition and Conference Guide and Website (see *Reportable Outcomes*, p. 9).

Reportable Outcomes

- Med-e-Tel 2006 brought together 400 participants from 48 countries, allowing to share experiences, ideas, research results and technological developments (among clinicians, healthcare professionals, industry representatives, military & government management, scientists, researchers) with the ultimate goal of advancing the use and implementation of ehealth, telemedicine and health ICT for the improvement of healthcare practice and healthcare delivery worldwide.

- **E-Health - Proceedings of Med-e-Tel 2006**

  Eds. M. Jordanova, F. Lievens, April 2006, 378 pp.
  Publisher: Luxexpo, 1347 Luxembourg, G.D. of Luxembourg
  Hard copy, hardcover, ISSN: 1819-186X
  CD-ROM, ISSN: 1818-9334

  Papers provided in these Proceedings were compiled for and presented at Med-e-Tel 2006. The event took place at Luxexpo, Luxembourg, Grand Duchy of Luxembourg, 5-7 April 2006. The Proceedings are an eclectic collection of essays, a collective experience of experts from different continents and different cultures. 109 presentations from 46 countries are included in it. The aim of the publication is to permit those who are planning to introduce ehealth/telemedicine applications in their regions or countries to rely on experiences of others in order to avoid mistakes and to reduce potential problems.
  Papers that were presented during the TATRC Symposium "Global Healthcare Challenges and Opportunities: The Role of Advanced Technology" are included on pp. 14-40.

  (see appendix I to this report for a complete copy of the Proceedings)

- **Med-e-Tel 2006 Exhibition and Conference Guide**

  The Exhibition and Conference Guide provides an overview of the complete Med-e-Tel 2006 conference program as well as conference abstracts, and also a list of participating companies, organizations and media.
  A TATRC full page general advertisement was featured on the inside cover page. Another full page announcement of the symposium that was organized by TATRC at Med-e-Tel (on the subject of "Global Healthcare Challenges and Opportunities: The Role of Advanced Technology") was also included on page 21. As TATRC was present with a poster exhibit on the Med-e-Tel exhibit floor, TATRC is also mentioned in the list of exhibtors (p. 32) and TATRC Symposium abstracts are listed in the Abstracts section of the Guide (all conference abstracts are listed alphabetically per title).

  (see appendix II to this report for a complete copy of the Exhibition and Conference Guide)

- **Med-e-Tel website**

  Med-e-Tel 2006 conference abstracts and presentation slides are available at http://www.medetel.lu/index.php?rub=educational_program&page=program.

Conclusions

Med-e-Tel 2006 was a successful event with 400 participants from 48 countries, a conference program with over 130 high quality presentations and an exhibition presenting products, technologies, systems and services from some 40 vendors, service providers and project consortia.

The format of the event – combining conference, exhibition and networking opportunities – is very well accepted and contents of the conference programs and exhibition were highly rated by a large majority of participants.

The networking aspect remains one of the strong points of the Med-e-Tel event. Bringing together participants from many different countries and continents, with various backgrounds (medical, IT, telecom, engineering, academic, military, government, and more) and with an abundance of practical experiences, gives participants unprecedented opportunities to learn from other people's successes or mistakes, to forge partnerships or to set up cooperation agreements, and overall to advance the use and implementation of telemedicine and ehealth applications around the world.

Med-e-Tel's aim, based on comments received during the Med-e-Tel 2006 event, is to continue along the same line, with a conference program that will focus even more on successful business cases and practical experiences, and that will keep on involving (by popular demand) organizations like the World Health Organization, Telemedicine and Advanced Technology Research Center, European Commission, and industry participants.

Med-e-Tel has become a leading telemedicine/ehealth event platform on the European continent, where we look forward to have TATRC as a permanent partner.

Appendix I

Med-e-Tel 2006 Proceedings

(391 pages)

E-Health

Proceedings of Med-e-Tel 2006

The International Trade Event and Conference for eHealth, Telemedicine and Health ICT

Editors:
Malina Jordanova, Frank Lievens

ISSN 1819-186X

April 5-7, 2006
Luxembourg, G. D. Of Luxembourg

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E-Health

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Editors: Malina Jordanova, Frank Lievens

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J-M. Collignon
CEO, Luxexpo

Foreword

F. Lievens
Intern. Coordinator
Med-e-Tel

Over the past decades, evolution in medical technologies and research, cultural, social and demographic changes, and globalization have confronted healthcare systems with new situations and subsequently require new solutions. The ultimate goal becomes that of delivering the best possible health service for anyone, at any time, from anywhere.

The dramatic increase of interest and application of ehealth/telemedicine during the past twenty years resulted in investments of billions. Nowadays, the integration of ehealth into the everyday life of medical staff and patients is a reality in developing as well as developed countries. The world is being digitalized.

Med-e-Tel (The International Trade Event and Conference for eHealth, Telemedicine and Health ICT - http://www.medetel.lu/index.php) focuses on the convergence of information and communication technology with medical applications, which lead to a higher quality of care, cost reductions, workflow efficiency, and widespread availability of healthcare services.

The aim of Med-e-Tel is to establish the scope of this modern communication health environment and to draw the lines of international action based on an overview and comparison of the current status of ehealth in numerous countries. It also stresses the major challenges involved in making several different industries coordinate their skills and efforts in order to achieve an optimal development within the healthcare environment using modern communication systems, before focusing on the role of networking for the successful implementation of ehealth. In order to achieve its goals, Med-e-Tel brings suppliers of specific equipment and service providers together with buyers, healthcare professionals, institutional decision makers and policy makers from many countries around the globe and provides them with hands-on experience and knowledge about currently available products, technologies and applications. Med-e-Tel is a forum where state-of-the-art products, ideas, projects, and so on are presented and discussed. Year after year it becomes a breeding ground for new cooperations and partnerships between scientific groups, healthcare institutions, industry associations, SMEs and large corporations from all over the world.

The Med-e-Tel 2006 edition called together participants from over 55 countries. International organizations like WHO, ESA, ITU, UNOOSA and EC were just some of the major players that took part in the event.

The preparation of these Proceedings is one example of our work together with many partners from all over the world. eHealth/Telemedicine is without doubt, an ICT application that will bring the benefits of health care and medical services to many countries. Many have already recognized it, and we see a rapidly increasing number of ehealth/telemedicine projects and partners. We are convinced that these Proceedings will provide you with useful information on various ehealth and telemedicine systems and solutions, on the benefits and problems that were encountered during or after implementation of ehealth and telemedicine systems or services, on lessons learnt, and thus will help those undertaking projects in the emerging ehealth/telemedicine needs of their own countries.

Jean-Michel Collignon
CEO, Luxexpo, Luxembourg
Producers of the Med-e-Tel Exhibition and Conference

Frank Lievens
International Coordinator, Med-e-Tel
Board Member, International Society for Telemedicine & eHealth , Switzerland

Preface

Papers provided in these Proceedings were compiled for and presented at the Med-e-Tel 2006 conference. The event was held at Luxexpo, Luxembourg, Grand Duchy of Luxembourg, 5-7 April 2006.

There were over 100 presentations from more than 55 countries. Luxexpo, Luxembourg is the organizer of the event.

At the very beginning, it is necessary to clarify that:

1. Both the sessions and the papers within the sessions are listed in the order of their actual presentation. Please, bear in mind that this is not alphabetical order.
2. The Proceedings do not represent a textbook on ehealth / telemedicine. A great deal has been written on the topic so far. To provide a list of references on ehealth and telemedicine would be a Herculean task and yet at the moment of publication the list would already be incomplete as ehealth is an evolving field and many of its parameters are largely undefined.
3. Despite the fact that papers from so many countries are included in the Proceedings, the collection does not represent an overview of ehealth / telemedicine achievements worldwide.

The Proceedings represent a collective experience of colleagues from different continents and different cultures. It is an eclectic collection of essays. The aim of the publication of these Proceedings is to permit those who are planning to introduce ehealth / telemedicine applications in their regions or countries to rely on experiences of others in order to avoid mistakes and to reduce potential problems.

We hope that anyone involved in ehealth / telemedicine will find these Proceedings extremely interesting. We also hope you will enjoy your reading.

Editors

Malina Jordanova
Educational Program Coordinator, Med-e-Tel, Bulgaria

Frank Lievens
International Coordinator, Med-e-Tel, Belgium
Board Member, International Society for Telemedicine & eHealth, Switzerland

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Session 1

Global Healthcare Challenges and Opportunities: The Role of Advanced Technology

Global Healthcare Challenges and Opportunities: The Role of Advanced Technology

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Abstract- Advances in healthcare delivery have led to dramatic improvements in the quality of life for many; however, a gap in care remains and widens with increasing populations still facing significant threats as ancient as malaria and as modern as bioterrorism. Novel solutions for many of these problems may be found by mining emerging technologies from a variety of non-medical disciplines such as information and materials science. For example, remote diagnostics and therapeutics (telemedicine) by means of low cost, linked biosensors reporting on both individual and population health can serve to improve care in the industrialized world and significantly extend it in the developing world. Several examples of such applications exist and while challenges in funding research and integrating into clinical practice are undeniable, the opportunities call for our focus as a world community.

HealthGrid: Grid Technologies for Biomedicine

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Abstract- This presentation will provide an overview of the development and future utility of Broadband Medical Networks and the Global Healthgrid, in addressing health problems of global concern.

Key words: Healthgrid, Broadband, Cyberinfrastructure, Network, Connectivity, Grid, Web Services, Service Oriented Architecture

Important trends in biomedical research include the rapid accumulation of data and a broadening scope of collaborative research activities. Biomedical environments require the creation and operation of Virtual Organizations to effectively support healthcare information for distributed communities of practice across organizational boundaries. Enhanced collaboration environments, visualizations tools, computational resources and storage capabilities are all GRID services upon which Virtual Organizations can build the necessary information infrastructure to create, administrator and manage biomedical information [1].

HealthGrid is a Virtual Organization where data of medical interest can be stored, processed and made easily available to different healthcare participants: researchers, physicians, healthcare organizations, the public health sector, healthcare administration, individual citizens and other communities of practice. [2] The Telemedicine Advanced Technology Research Center (TATRC) has initiated a new area of research on HealthGrid, with the objective to create a biomedical research environment envisioned to be the contemporary equivalent of the original DARPA Net. The digitization of biomedicine will constitute a far greater revolution than the digitization of information technologies [3]. As the Department of Defense moves towards "Net Centric Warfare", GRID infrastructure offers the necessary guarantees in terms of security, respect for ethics and observance of standard regulatory frameworks for the Military Healthcare System. [4]

However, in the first decades of broadband technology and GRID computing many of these potential benefits have not been realized. While a number of disease specific GRID projects (cancer GRID (caBIG), Models of Infectious Disease Agents Study (MIDAS), Biomedical Informatics Research Network (BIRN), etc.) have developed tools to carve out specific solutions, the biomedical community has the larger need to demonstrate that GRID approaches scale to broader everyday areas of application. The U.S. Military Health System is home to the world's largest operational health system, containing a rich set of medical data. The advent of GRID technology provides a mechanism for high quality longitudinal analysis of medical data, with the potential to foster an environment that provides knowledge fro future generations of biomedical scientists and care providers.

Use of GRID technologies for biomedicine is at a developmental "choke point" beyond which a dramatic expansion of its utility and functionality cannot be realized caused TATRC to convene an Integrated Research Team on "HealthGrid: GRID Technologies for Biomedicine". Leading subject matter experts from biomedicine and computer science came together to identify opportunities and formulate a plan to propel the application of GRID technologies through this choke point towards changing the practice of medicine as we know it. The findings of the resulting U.S. HealthGrid Roadmap provides opportunities and funding over the next five years to effective an approach to collaborative partnerships in the interplay between biomedical and computer science. Specific findings include the following opportunities for HealthGrid:

- Access to remote data sources (DB, instrumentation, personal presence);
- Utilization of advanced simulation for complex scenarios to enhance strategic decisions;
- Anatomical modeling, to the degree that 'tricoder' visualizations and real-time simulation is run to support Electronic Health Records;
- Discovery of new knowledge to enhance predictive models for situational awareness;

- Global science networks to provide interplay with environmental, agricultural, bio-energy and other sectors;
- Enabling extractions of new information for predictive, preventative, personalize, participatory healthcare by a reduction in data dimensionality;
- Meta data inventory of healthcare data.

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From the Front Lines: Innovating Mobile Health Care Solutions Bridging the Technology and Clinical Gap

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Abstract- One of the goals of the of the Battlefield Medical Information System-Telemedicine (BMIST) architecture and technologies was to develop a self scaling mobile health care architecture to empower medics and providers with access to critical medical information to improve healthcare. The BMIST architectural standard provides the capability to capture, generate and self scaling information making information available to the right people. The BMIST supports point-of-care wireless monitoring to assist medical personnel with decision support and treatment. Medical personnel can also use it to record vital sign information directly into the clinical encounters and transmit those records to a central repository. The BMIST Architectural Standard makes it simple to develop user-friendly point-of-care technologies and manage medical information. With more than 20,000 BMIST in use world-wide we are collecting thousands of encounters providing a gradual aggregation of resources to aid in the development of future mobile healthcare solutions, transforming business processes and driving organization-wide benefits.

Telemedicine Standardization -- The Need for an Operational Approach

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NOTE: "Opinions, interpretations, conclusions, and recommendations are those of the author and are not necessarily endorsed by the U.S. Army."

For the expansion of multinational telemedicine operations, a sine qua non which has been well demonstrated is that of standardization. There are many agencies and organizations working in the realm of technical and communications standards, but few are working in the arena of operational standards. NATO is one exception, and its recent success in establishing a Standardisation Agreement (STANAG) on the development of Teleconsultation systems may be held up as an example for emulation. Recent NATO military operations have demonstrated both a need for and a lack of interoperability in the area of Telemedicine. Since multinational operations seem to be the wave of the future, and multinational medical support will be mandatory for provision of best care to the patients, NATO has developed an interest in the area of the provision of Teleconsultation across national boundaries. Work in this arena has been carried out by the NATO Telemedicine Panel, and this presentation will discuss the approach of the Telemedicine Panel to standardise and improve multinational Telemedicine support to military operations. The Panel has chosen for practical reasons to concentrate its efforts on Teleconsultation rather than on the broader definitions of Telemedicine, which include patient education, home health care, and monitoring for patients with chronic diseases, due to the fact that these broader areas are not within the purview of NATO, being strictly national responsibilities. The emphasis of the Panel is on Business Processes, rather than technical or clinical standards, and the rationale for this decision will be discussed.

Any one of us who has worked in the Telemedicine (TMED) arena is very aware of standards, and the need for them. However, there has been demonstrated frequently a tendency to get bogged down in arguments about specific standards and to ignore others which may actually be more important. A review of the TMED literature over the past 10 years demonstrates several salient facts:

1. The equipment to successfully carry out TMED clinical practice is a reality—it works;
2. Many small demonstration projects are successful; and
3. Once we attempt to spread these pilot projects over a larger area, or into the multinational or multi-jurisdictional arena, there are many more failures than successes.

I would hold that one reason for the third point is that generally inadequate attention is paid to the right kind of standards. Innovators of systems and projects have frequently tended to concentrate only on technical or clinical standards, but have paid insufficient attention to what I would term operational standardization. The old concept of “build it and they will use it” is simply not realistic.

For the expansion of multinational telemedicine operations, a sine qua non which has been well demonstrated is that of standardization. I know of no one who would dispute that. There are many agencies and organizations working in the realm of technical and communications standards, and some working in the area of clinical standards, but few are working in the arena of operational standards. NATO is one exception, and its recent success in establishing a Standardisation Agreement (STANAG) on the development of Teleconsultation systems may be held up as an example for emulation.

Recent NATO military operations in the Balkans and Afghanistan have demonstrated both a need for and a lack of interoperability in the area of Telemedicine. Since multinational operations seem to be the wave of the future for NATO, and multinational medical support will be mandatory for provision of best care to the patients, NATO has developed an interest in the area of the provision of Teleconsultation across national boundaries. Work in this arena has been carried out by the NATO Telemedicine Expert Team, and this presentation will discuss the approach of the Team to standardise and improve multinational Telemedicine support to military operations. It appears to me that this

approach would be of benefit in the establishment of any TMED systems or programs which cross regulatory or jurisdictional boundaries, whether multi-national or of various regions (states) within a nation. Therefore, I would like to discuss the approach of NATO to TMED standardization.

NATO has a well-developed standardisation program which addresses many issues, but the issue of telemedicine interoperability was not addressed until its lack became evident during operations in the Balkans. The General Medical Working Group of NATO (GMWG), recognizing that this issue needed discussion, invited presentations on the subject of Telemedicine in deployments at its June 2000 meeting. After several presentations on topical issues, a two-day meeting of Telemedicine experts from several nations was convened to develop a plan of action. The purpose of this group was to determine the need for, and if needed, to develop telemedicine interoperability standards for use among deployed NATO forces. After its initial meeting, this group recommended the development of Telemedicine standards and doctrine on a NATO-wide basis, and accordingly the GMWG established a permanent Telemedicine Panel (since renamed the TMED Expert Team) to carry out the work. To ensure full coordination of the TMED effort with the overall NATO effort to develop a Medical Communication and Information System (MedCIS), the Expert Team has recently been made a sub-group of the NATO MedCIS Panel.

You would think that an organization such as NATO, which has been carrying out standardization activities for more than 50 years, would be able to develop TMED standards in a heartbeat—not so. Sometimes even the simplest things are difficult…. There are several realities of NATO Medical Care which make TMED standardization a difficult process:

1. There is NO NATO Health Care System—all medical care is nationally provided—NATO per se, as an alliance, owns not so much as a band-aid.
2. Thus, there is no standard medical record keeping (Specifically, there is no standard Electronic Health Record)
3. There are varying levels of national interest--Some are very far advanced in Telemedicine, and others not at all
4. Some Proprietary systems are already in place, and are serving as "stovepipes" for information
5. In some countries, there has been perceived a political lack of will to expand TMED to other countries

Taking all that into account, the Team has had to take a very generic view of the issues, and proceed slowly. They decided to:

1. Collect and analyze prior Telemedicine concepts developed from other organizations;
2. Identify individual NATO member (as well as Partnership For Peace [PFP]) nations' concepts for deployable telemedicine systems;
3. Establish & promote a NATO Telemedicine "Vision" for future clinical care using this modality across the entire spectrum of military operations; and to
4. Leverage work done by other bodies-- ITU, G8, Industry, ISO, etc. – THE GUIDELINE WAS--DON'T REINVENT THE WHEEL!!

Our first effort was to examine the whole concept of standardization, as it applies to Telemedicine. We realized that no matter what aspects of TMED you were interested in, there were essentially three parts to the TMED conundrum. The first is that of technical standards, which is not only the first area of standardization to come to mind, but also one in which most work is currently ongoing. There are literally innumerable international, commercial, and clinical entities attempting to establish technical standards. These include most of those with which you are familiar, including HL7, DICOM-3, JPEG, MPEG, and many others. We realized that while we would have to agree to incorporate certain of these standards into our system, we were not the most appropriate group to attempt to develop new technical standards. We did agree to adopt certain standards for use in the NATO environment, but have refrained from attempting to develop any new standards.

The second is that of clinical standards, to include training, certification of users, and quality assurance. Within NATO, these are all aspects of healthcare, and are thus the responsibilities of the member nations rather than the alliance as a whole.

It is, however, in the third (and arguably most important) area of standardization in which we felt we could have a real impact on TMED within the Alliance—That of operational standardization. As I alluded to previously, a review of the literature on TMED implementation finds only a few programs which have failed due to inadequate clinical standardization, and only slightly fewer which have failed due to inappropriate technical standardization, while innumerable ones have failed to develop after pilot projects because of lack of acceptance, and failure to develop an agreed way of doing business—i.e. operational standardization. Another term which may be used to discuss this issue is that of standardized business practices. This is the area in which we have decided to concentrate our work.

What do we mean by operational standardization? We mean any agreement on procedures and utilization policies which can be agreed by the nations.

After a review of NATO policy and doctrine, as well as the TMED literature, we have realized that TMED in the multinational military setting has several basic requirements:

1. Clinical operational concepts must be developed and validated before, and implemented with, technical concepts;
2. Integration of telemedicine operations within military operations requires close attention to operational constraints;
3. Military telemedicine systems should be integrated within other strategic and tactical command, control, communications & intelligence systems;
4. Continuing and sustained training and integrated logistical support are essential;
5. Coalition military telemedicine operations require both technical and operational interoperability;
6. Store-and-forward teleconsultation has to date proven more useful for clinical care in field settings than has real-time video teleconferencing;
7. Development of a digital medical record would enhance the use and integration of telemedicine systems with other health services support; and
8. Telemedicine systems are used as much for situational awareness, medical command and control, and continuing medical education as for teleconsultation—these other uses are legitimate and their importance should not be underestimated.

Accordingly, our emphasis was first on development of policy and doctrine which recognized that TMED could play a role in NATO medical support structures, and that it was desirable to develop an operational process to support its use. Though time-consuming and protracted, this effort was seen as a necessary first step. We have written the concept of TMED into the doctrinal documents, and inserted memory-joggers regarding TMED into NATO's operational planning documents. We published and had adopted by NATO a standardization agreement which not only established the rules by which Teleconsultation systems could be developed, but which established a list of technical standards which would be used in these national systems. Further, we established a desired minimum TMED capability requirement for each level of medical care in NATO, which would materially assist our multinational medical operations. This effort has been successful, and numerous national military TMED systems are now being developed or modified in accordance with our recommendations.

We are now concentrating our efforts on other aspects of business practices involved in multinational TMED, and are beginning to develop the documents which will govern this effort in years to come. We are examining the whole concept of legal issues involved in the provision of multinational Telemedicine support within the NATO arena, and additionally are developing policies on: security of data and patient privacy, patient consent, digital signatures, documentation of consultations, metrics to be used in evaluation of such systems, and the use of PKI within NATO medical circles.

To increase clinician confidence in the provision of care with the use of multinational TMED, we have run a small pilot study comparing the concordance and utility of consults given by consultants from several nations to standardized cases. A very favorable report on this preliminary study was presented last month, and we are now working on planning a larger and more detailed study as a follow-up.

The NATO Medical authorities (COMEDS) have listed TMED-related issues in their goals and objectives documents for the next several years, and we are currently addressing some of their concerns. These include several items, all of which fall into what I have called "Operational Standardisation". These include the need for the identification of common clinical process architectures (High Level Business Architectures) between the TMED Expert Team and the MedCIS Panel, to ensure that the in-development NATO MedCIS will support and be supported by TMED. This effort includes the development of requirements for a common technical and communications architecture, which takes full account of security/patient privacy considerations.

Our continuing efforts include:

1. The need for identification of common clinical process architectures (High Level Business Architectures) between the TMED Expert Team and the MedCIS Panel;
2. Development and submission of requirements for a common technical/communications architecture, to include Security/Patient Privacy considerations; and
3. Planning for our full-scale demonstration project, which is planned to look at reproducibility of results in a multinational Teleconsultation environment.

The rapid acceptance of our efforts at standardization by the nations of NATO and the Partnership For Peace has shown that our emphasis on operational standards or common business practices, has been the best indicator that the nations agree with our assessment of the need for this type of standardization in our environment. I would highly recommend emphasis on this type of issue for any of you who are working in the area of large-scale or multinational TMED

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The United States Army Telemedicine Program – General Overview and Current Status in Southwest Asia

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Telemedicine support for forward deployed Army Combat Support Hospitals in Iraq was initiated in 2004. Clinical reach-back consultation for medical specialties included radiology, pathology, dermatology, ophthalmology, infectious disease, pediatrics, nephrology, burn/trauma and dentistry. Tele-consultations was accomplished using satellite connectivity over the non-secure military Internet network using both e-mail with JPEG image attachments and DICOM server file transfers. As of December 2005, over 1100 non-radiology consults were completed. Radiology image transfers exceeded 10,000 and include intra- and inter-facility file transfers (to the referring medical facility in Germany). Measures of clinical effectiveness included the number of avoided aeromedical evacuations, decreased lost duty time, and intra-theater medical management of complex cases which improved access to sub-specialty care. Deployment problems encountered included frequent interruption of electrical power, initial bandwidth constraints, and network reconfiguration delaying initial implementation of teleradiology. A follow-on deployment to sites in Kuwait and Afghanistan for tele-radiolgy was completed in January 2005.

I. Introduction

For decades, military health care providers who are forward-deployed to support war, low intensity conflicts or humanitarian missions have strived to communicate with intra-theater or extra-theater medical specialists in efforts to provide better patient care. Often, specialists were nearby and communications and coordination was possible. Modern battle plans now call for speed and agility on the battlefield and smaller more mobile fighting units. This has resulted in the need to share just-in-time medical information and bridge the knowledge gap that can occur between deployed providers and rear echelon medical specialists.

II. Army Medical Department (AMEDD) Organization

The AMEDD today operates eight Army medical centers, 26 medical department activities, and numerous clinics in the United States, Europe and Japan which are grouped under six major subordinate commands called regional medical commands. Together, these organizations are manned with 27,000 soldiers and 28,000 civilian employees. Another 20,000 active-duty medical soldiers are in field units. The National Guard and Army Reserve have over 30,000 medical soldiers. The AMEDD's corporate budget of $9.7 billion provides care for more than 5 million beneficiaries – active duty members of all services, retirees and their families. To address the health care needs of this geographically diverse beneficiary population, the U. S. Army adopted "telemedicine" in 1992 to meet the health needs of deployed soldiers.

III. Background on U. S. Army Telemedicine

The U. S. Army Medical Department (AMEDD) Telemedicine program began in 1992 with deployment of a tele-consultation reach-back capability from Somalia to the AMEDD. The technologies used included a satellite transceiver dish, laptop computers and digital cameras. The system was simple to use and showed value in augmenting care to remote providers in austere environments. From this initial experience, numerous follow on deployments of telemedicine capabilities included Croatia (1994), Germany (1994), Haiti (1995), Bosnia (1995), Kosovo (1996), Kenya (1998), Afghanistan (2002), Kuwait (2004) and Iraq (2004). Again noted at each of these sites was improvement in clinical care to deployed soldiers with improved access to specialty care and avoidance in unnecessary medical evacuations for conditions that can be resolved in theater with tele-consultation (dermatology and radiology).

Concurrent with the deployment of Telemedicine capabilities to deployed U. S. Army forces from 1992 to 1995, there was the establishment of regional telemedicine offices at the U.S. Army medical centers situated in the continental United States. The program strategic direction in establishing these regional telemedicine offices was to bridge the continuum of care from sustaining bases in the United States to deployed forces requiring sub-specialty care, such as

dermatology, that is often lacking in a deployed environment. In 1994, the primary U. S. Army telemedicine office was established to set the AMEDD vision, research and development, and deployment capability for telemedicine. This office is the Telemedicine and Advanced Technology Research Center (TATRC), located at the U. S. Army Medical Research and Materiel Command (USAMRMC), Fort Detrick, MD. The TATRC has been the lead AMEDD office to sustain and expand the U. S. Army telemedicine program world-wide since 1994.

IV. PEACETIME TELEMEDICINE CLINICAL APPLICATIONS

Since 1992, the AMEDD investment in telehealth has become worldwide and includes over 70 deployed tele-radiology systems, 22 tele-pathology systems that are linked to the Armed Forces Institute for Pathology in Washington, DC, tele-ophthalmology, and tele-dermatology.

Regional expertise includes the Landstuhl Regional Medical Command in Germany as the tele-radiology hub for Europe and Southwest Asia (thousands of radiology images interpreted and archived each month); Brooke Army Medical Center in San Antonio, TX for tele-dermatology (500 consults/month) and tele-cardiac echocardiography (300 consults/month); Tripler Army Medical Center in Honolulu, HI for tele-pediatrics (30 consults/month) and the electronic Intensive Care Unit (eICU) support to the Guam Naval medical facility; and the Walter Reed Army Medical Center in Washington, DC for tele-psychiatry (140 consults/month) and tele-neurosurgery (30 consults/month).

Telemedicine measures of effectiveness demonstrated from these state-side telemedicine programs includes improved access to specialty care (demonstrated by all tele-consult specialties), avoided or facilitated medical evacuations due to second opinion consults (especially dermatology), cost savings by avoiding out-sourcing to the civilian care sector (demonstrated with tele-cardiac echocardiography, tele-psychiatry and tele-neurosurgery), and improved continuity of care by providing longitudinal medical imagery collected at remote medical sites and transmitted to medical centers for interpretation and archiving (tele-radiology).

Since 2002, the Tele-cardiology program at Brooke Army Medical Center (BAMC) in San Antonio, TX has done over 6000 tele-cardiac echocardiograms from outlying Army medical clinics in Oklahoma, Missouri and Louisiana which would have cost over $2.5M if provided by local civilian purchased care networks. Similar cost avoidance savings were realized for the Teledermatology program at BAMC where over 12,000 consults from over 25 referring tri-service military medical facilities were completed in the Feb 2002 to Apr 2005 time frame saving nearly $900K in costs to the military care network.

In addition, the U. S. Army Medical Department (Tripler Army Medical Center, Honolulu, HI and Walter Reed Army Medical Center, Washington, DC) has participated since 1999 with the Joslin Diabetes Center in Boston, MA and numerous VA medical centers (Togus, ME, Boston, MA and Honolulu, HI) in a funded research initiative looking at the use of tele-retinal imaging, in hopes of avoiding one of the most preventable causes of blindness – diabetic retinopathy. The major goals of this program are the establishment of a telemedicine system for comprehensive diabetes management and the assessment of diabetic retinopathy that 1) provides increased access for diabetic patients to appropriate care, 2) centralizes the patients in the care process, 3) empowers the patient to better manage their disease, 4) that can be performed in a cost effective manner and 5) maintains the high standard of care required for the appropriate management of diabetic patients. Since inception of this program, 6 different reading center sites have been established within the DOD, VA, and the Indian Health Services.

V. DEPLOYMENT TELEMEDICINE

Operational telemedicine support for forward deployed Army Combat Support Hospitals in Iraq was conducted in July 2004. Measures of clinical effectiveness observed since inception include the number of avoided aero medical evacuations, decreased lost duty time, and intra-theater medical management of complex cases. Clinical reach-back consultation for a range of medical specialties included radiology, pathology, dermatology, ophthalmology, and dentistry. Tele-consultations was initially accomplished using satellite connectivity over the military Internet network using both e-mail with digital image attachments and secure server file transfers.

VI. TELE-CONSULTATION SERVICES USING ELECTRONIC MAIL AND DIGITAL IMAGE ATTACHMENTS

In April 2004, the U. S. Army Medical Department approved the use of the U. S. Army electronic mail (e-mail) system known as Army Knowledge On-line (AKO) for teledermatology consultations from deployed providers in Iraq, Kuwait and Afghanistan. Through AKO, this teleconsultation service provides a centralized business practice to manage consultation requests in a secure, timely, and consistent manner between deployed medical providers and rear-based consultants. To obtain a consult, the deployed health care provider initiates an e-mail and enters an adequate description of the patient's condition and attaches digital images necessary to illustrate the patient's condition. Upon transmission, the e-mail is sent to an on-duty clinical specialist (i. e. dermatologist) who will respond to the deployed provider within 6 hours for urgent requests and 24 hours for routine requests. See Annex A: Digital imagery and e-mail instructions for remote tele-consultations, for additional discussion for consult submission.

The AKO tele-consultation is not encrypted, therefore to remain within compliance with Public Law 104-191, Health Insurance Portability and Accountability Act (HIPAA), consultation requests must not include Protected Health

Information (PHI). Digital imagery must obscure the face or identifiable markings unless required for a diagnosis. This consultation service is designed for use by all DOD healthcare providers, with special concentration on deployed or otherwise isolated healthcare providers serving at any Army, Air Force, Navy, or Marine facility. Special Forces Medics and Independent Duty Medical Technicians (US Air Force) working under the authority of a physician may submit tele-consultations.

To date, the system has expanded beyond teledermatology and includes 9 clinical specialty services available: dermatology, infectious disease, ocular health, burn, trauma, nephrology, cardiology, toxicology and pediatric intensive care (see Figure 1).

As of January 2006, over 1000 dermatology, 70 ophthalmology, 125 infectious diseases, approximately 1000 dentistry, and 700 pathology tele-consults were completed. The average response time for stateside medical consultants to answer the tele-consult, across all specialties was less than 5 hours. Teledermatology referrals resulted in more than 50 avoided aero medical evacuations (potential cost savings of $1.0M), and 7 cases where evacuation was facilitated by tele-consultation. Over 460 deployed providers have used the US Army Tele-consultation system with approximately 20% of the consults coming from US Air Force and US Navy deployed providers. Deployment problems encountered included frequent interruption of electrical power, initial bandwidth constraints, and frequent marketing campaigns to inform newly arrived personnel in theater of the AKO tele-consultation capability. Over 80% of all tele-consults from deployed providers came from Iraq, Kuwait or Afghanistan.

VII. DEPLOYABLE TELERADIOLOGY SYSTEM (DTRS)

Teleradiology services include medical information systems designed for acquiring, managing, interpreting, reviewing, transmitting and storing digitized diagnostic images and related patient information on a DoD secure open systems platform. The lack of Secure DTRS Web servers early in the Iraqi theater of operations, had led to the loss of patient healthcare information in theater, the inability to move critical diagnostic images throughout the hospital (to include the operating room and the emergency room), deny greater clinical collaboration with higher echelons of health care, and provide a means to electronically transmit and archive patient health care data/imagery under Federal law - Health Insurance Portability and Accountability Act (HIPAA),

With the introduction of computerized radiology devices at Troop Clinics and Combat Support Hospitals (CSH), there is a need to transmit these images to radiologists for diagnosis, consultation, or validation of initial reading, as well as sending radiology images for archiving and as part of a clinical consultation. The Deployable Teleradiology System (DTRS), a commercial off-the shelf product (MEDWEB, San Francisco, CA), is a web-based teleradiology product with unusually robust and secure communications capabilities, as well as the ability to convert all image input device signals into a DICOM standard. The DTRS also provides the capability for immediate local distribution of digital medical images throughout a fixed or mobile medical facility, provides historical archiving of images, and secure transmission of images between medical facilities for interpretation and/or subspecialty consultation. The DTRS servers provide the physical hardware hub and information processing center for all radiology systems and services within the Combat Support Hospitals. Residing on the CSHs Local Area Networks (LAN), medical diagnostic images and patient information will be stored locally and then securely transmitted to higher echelons of care as patients' transition from the theater hospital to sustaining base Medical Centers.

Since 2001, the Army's Picture Archive and Communication System (PACS) Program Management Office (APPMO), Fort Detrick, MD began deploying Teleradiology systems to approximately 35 sites throughout Europe to support the regional radiology service needs and improved turnaround times for interpretation and reporting from 21 days to overnight completion. Since that time, over 70 systems have been deployed successfully around the world at Army sites, including all major medical centers, force protection platforms, and South Korea. The AMEDD is nearly 100% digital in its medical radiology imaging capability.

In late 2002, US Army Europe (USAREUR) purchased DTRS for Kosovo and Bosnia. The Landstuhl Regional Medical Center (LRMC) in Germany conducted prototype testing of this functionality, providing radiology subspecialty support to those remote sites and more fully utilized deployed radiologists by sending overflow workload from Europe to Kosovo or Bosnia when the operational tempo was slow. Based on LRMC's success in Bosnia and Kosovo and in consultation with the APPMO, the Telemedicine and Advanced Technology Research Center (TATRC), Fort Detrick, MD deployed DTRS to Afghanistan in October 2002 as part of Operation Enduring Freedom in support of the 339th Combat Support Hospital (CSH). Since 2002, the Bagram military medical facility has been transmitting on average, 50 studies per month to LRMC for clinical continuity of care for airevac'ed soldiers. In November 2005, an additional 2 DTRS's were deployed to Afghanistan at Kandahar and Salerno medical facilities.

In June 2004, the DTRS systems were deployed to Baghdad and Balad, Iraq. Additional systems were procured and sent to three Kuwait sites in January 2005.

In January 2005, expansion of the teleradiology storage and distribution functionality for deployed hospitals in Iraq was completed with the deployment of a DTRS to the Mosul military hospital. An Operational Needs Statement (ONS) for further DTRS deployment to four additional sites in Iraq has

been approved in May 2005 and is scheduled for implementation in the March 2006 time period.

Radiology image transfers were confined to thousands of intra-facility use while inter-facility file transfer to the referring medical facility in Germany began in November 2004. The workload for CY2004 for exams sent from Bosnia, Kosovo and Afghanistan to the LRMC in Germany exceeded 5200 patients. From the 3 DTRS sites in Kuwait (deployed in Jan 2005), the weekly average for image transmission to the LRMC is 150 patient studies and for the 3 DTRS sites in Iraq, the weekly average is 1300 exams per week.

In addition to moving imagery from one point to another within the hospital, the DTRS servers provide a means of storing medical imagery and patient information for long-term retrieval and forwarding diagnostic information on patients evacuated to higher echelons of health care outside theater, providing a more complete medical record of injury and subsequent care. Beneficial to the long term care of soldiers, the DTRS servers inherently support the Army Medical Departments goal in providing an electronic medical record that remains with the soldier long after leaving the battlefield.

The key problem that is compromising the ability to archive all digital images transmitted from theater to the LRMC PACS is the incompatibility of the various hospital information systems (HIS) currently in use at LRMC and deployed Medical Treatment Facilities. The APPMO is working to reconcile this problem by upgrading deployed DTRS systems with software that will in addition enable upgrades to HIS systems. In addition, USAMRMC Acquisition office is the materiel developer for DTRS and is trying to improve sustainment support and in-theater maintenance by interfacing a Global Teleradiology Support Node server (MEDWEB server at San Antonio, TX) with deployed DTRS' for software upgrades and tele-medical maintenance, as well as establish a central training curriculum and operational site at USAMRMC for identified medical technicians scheduled to deploy with all digital radiology equipment assembled. These are all important enhancements to the DTRS program as this deployed tele-radiology capability continues to expand in theater.

Virtual Reality for Behavioral Healthcare

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Simulation technology has long been used to train individuals in highly specialized fields. For example, the U.S. Air Force and NASA used simulations to allow pilots and astronauts to practice maneuvers in a safe environment before attempting these complicated tasks in the real world. However, new applications of these technologies are enabling residents to practice surgery without endangering human life, encouraging patients to complete physical therapy without resistance, and allowing individuals to overcome their fears and distorted cognitions in the privacy of their clinician's office.

The applications of simulation technology in health care are numerous. Below is a partial list of the uses that are currently being investigated:

- Treatment of anxiety disorders, including specific phobias, panic disorder, agoraphobia, social phobia, and posttraumatic stress disorder,
- Treatment of eating disorders and obesity
- Assessment and treatment of schizophrenia
- Assessment and treatment of attention deficit disorder
- Skills training in autism
- Treatment and Diagnosis of Cognitive Deficits
- Physical Rehabilitation
- Management of chronic pain
- Distraction from pain associated with medical and dental procedures
- Quality of Life in Individuals with Chronic Illnesses
- Empathy
- Stress inoculation training

Simulation technology has allowed clinicians to treat patients more effectively and efficiently, without concerns of excessive cost, loss of confidentiality and limited safety that arise with many conventional treatments. The therapeutic benefits of using simulations are becoming increasingly well recognized and fully supported with results from controlled clinical trials. With more than 1,000 papers already indexed in Medline, it is certain that simulation technology is a strong force in health care.

Throughout the history of development of simulations for health care use, success has depended on a triad made up of clinicians, technicians, and patients working together to create effective simulations. No part of this triad can create a successful application on its own. Thus, it is essential that attendees of this conference are able to learn about the possibilities of computer simulations in health care so that multi-disciplinary teams can be created that will work together to advance the field. This discussion is an important way to bring various experts out of their own corner of the scientific universe to collaborate on projects that will expand options for patients and their care givers.

I. Introduction

Virtual Reality (VR) is a technology that alters the way individuals interact with computers. It can be defined as a set of computer technologies that, when combined, provide an interface to a 3-D, computer-generated world. Users can navigate and interact with this synthetic world in real time, where their actions and reactions are experienced in the present moment. VR worlds are very effective at eliciting the same emotional responses that the user experiences in the real world. Therefore, VR has proven useful as an aid to exposure

Figure 1. VR Head-Mounted Device

therapy in conjunction with cognitive behavioral therapy (CBT) for a variety of anxiety disorders, including PTSD.

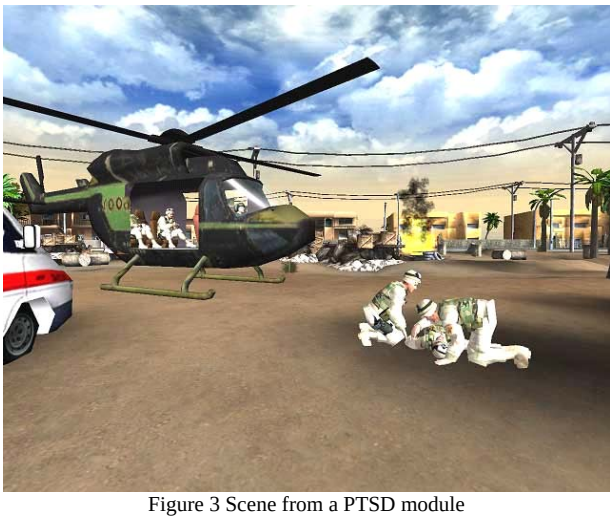

Figure 3 Scene from a PTSD module

The computer-generated world or environment, which can run on a PC, is made possible by a variety of computer peripheral devices, such as head-mounted displays, joysticks, and even rumble cushions or vests that imitate the feel of being inside a car or plane. The visual world is created through advanced computer graphics. A tracking device tells the computer where the user is looking based on head movement (systems are being developed that are able to determine eye movement), and the scene is viewed on an image system such as a large high-resolution digital display. Small speakers channel sound directly from the computer to the user. [Figure 1] Thus, with different kinds of software, users can navigate a variety of virtual worlds, whether the therapeutic environment calls for the subway in a virtual city or a helicopter evacuation of wounded personnel in Iraq [Figures 2 and 3]. Scenarios can be enhanced and customized with additions such as scent or wind from a fan, which can greatly increase the user's feeling of being inside the virtual world, and objects can be added or subtracted by the therapist using a computer interface.

Figure 2 Subway scene from a VR module

II. Applying VR to Therapy

Virtual environments have begun to attract much attention in clinical medicine. The underlying concept is that VR can act as an adjunct to treatments such as cognitive behavioral therapy (CBT) by effectively exposing the patient to an anxiety-inducing or feared situation. CBT targets the patient's distorted threat appraisal assumptions and process in order to reverse dysfunctional thinking patterns associated with depression, anxiety, phobias, and PTSD. Therapists help patients target inappropriate automatic cognitive, affective, physiological, and behavioral responses to current events and focus instead on rational responses appropriate to the situation. Exposure-based therapy helps patients decrease their fear response to internal and external cues that otherwise cause symptom intensification.

Exposure therapy is based on emotional processing theory (EPT). Applying EPT to PTSD, fear memories are stored as a "fear structure" and include psychological and physiological information about stimuli, meaning, and responses [1]. Once accessed and emotionally engaged, the structure is open to modification and, over time, will result in habituation and extinction of the fear response.

Engaging these principles, VR can aid exposure therapy by gradually immersing the patient in the anxiety-causing situation (this is known as virtual reality graded exposure therapy, or VRGET). Graded exposure therapy attempts to elicit arousal at the level the patient can tolerate and then increase exposure gradually as the patient learns skills to modulate arousal. This approach is most often coupled with a skill-based de-arousal method, such as relaxation training, distancing, and/or attentional retraining.

VRGET overcomes many of the shortcomings of imaginal exposure by providing external visual and auditory stimuli for the patient, thus eliminating the need for intense imagination skills. And, unlike in vivo therapy, which takes the patient into real-world scenarios (such as boarding an actual airplane), VR permits the patient to interact with anxiety-inducing scenarios in the safety and confidentiality of the therapy room. The ability of patients to feel they exert some measure of initial control over the situation also seems a

safer, more tolerable starting point for many. In addition, the therapist and patient, in their therapeutic alliance, can determine and control the exact "dosage" (in terms of duration and intensity) of the exposure exercise without constantly having to deal with the constraints and uncertainties of the real world. Multiple exposures can also be done during a single therapy session, making for more efficient time usage.

One of the most important advantages of VR is the flexibility it allows therapists and clinicians during therapy. In the current state of therapeutic VR development, the situations allow some degree of adjustment or individualization by the therapist to best synchronize them with the patient's specific fears. For example, strangers can be added to or subtracted from scenes, the height of a platform or the size of a phobic object can be adjusted, objects can be blurred, and the intensity of accompanying sounds can be regulated.

III. VIRTUAL REALITY EXPOSURE THERAPY FOR PTSD

Posttraumatic Stress Disorder (PTSD) affects an estimated 5.2 million Americans in any given year [2], often resulting in a diminished quality of life and considerable emotional suffering. Symptoms of PTSD typically appear within three months of the trauma, and can occur at any age. Symptoms including re-experiencing of the trauma, avoidance, and hyperarousal can vary over time. Even in individuals without a predisposing condition, PTSD may develop if the stressor is particularly extreme [3]. According to recent reports, the number of Iraq War soldiers who will experience PTSD is higher than the Gulf War due to such factors as ground combat and long deployments [4]. In the only study of military personnel in current theatres, Army and Marine Corps personnel returning from duty in Iraq demonstrate PTSD (using a broad definition) rates of 18% and 20%, respectively, compared to 12% of Army personnel returning from Afghanistan [5].

The current standard of care for PTSD is imaginal exposure (IE) therapy, the efficacy of which has been established in multiple studies with diverse trauma populations [1, 6, 7]. However, since avoidance of trauma reminders is inherent in PTSD, some patients are unable to engage either emotionally or cognitively in IE. In studies that address treatment non-responders, failure to engage emotionally or visualize well enough to elicit an emotional response are cited as most predictive of non-response, since the fear structure is not accessed and therefore not open to change [6, 8, 9] Exposure therapy for PTSD has not been done in vivo as often as for other anxiety disorders due to the impractical, and often dangerous, nature of recreating many traumas [1].

This is where virtual reality exposure therapy (VRET) may provide an excellent middle ground. By placing the patients in a virtual Iraqi setting, or other environment where a trauma has occurred, and then having them slowly experience that situation in a controlled way, the patient may begin to habituate to their PTSD symptoms and come to reappraise the situation, allowing emotional processing to fully occur and thus free them from the past.

VRGET studies on PTSD have not been as widespread as those investigating other anxiety disorders; however, several studies do show promise in various groups of PTSD sufferers. Three initial reports detail the use of VR to treat PTSD in Vietnam veterans. In the first case study in 1999, a 50-year-old male who had served in Vietnam 26 years before and met DSM-IV criteria for PTSD, major depressive disorder, and past alcohol abuse underwent VR exposure therapy. It was found that PTSD symptoms decreased 34% following treatment, and the self-reported symptom levels dropped by 45%. These gains held for three and six month follow-ups [10]. It was also noted that depression, anger, and substance abuse levels did not rise, as has sometimes occurred during exposure therapy with Vietnam Veterans [11]. In a discussion with several other Vietnam veterans who participated in the study, it was noted that patients had little trouble accepting the cartoon-like quality of the virtual environment (graphic quality has since been improved), but demonstrated a marked sensitivity to smaller details, such as whether gunfire sounded as if it was incoming or outgoing, or the manner in which the helicopter made its landing. It was generally observed that exact reproductions are not necessary to elicit anxiety [12].

In a follow-up article published in 2001, Rothbaum et al. reported on 10 Vietnam veterans with PTSD. The 8 participants contacted at the six month follow-up reported a decrease in PTSD symptoms ranging from 15% to 67%. Participants reported that intrusion symptoms were significantly lower three months after therapy. This statistical significance did not hold at the six month follow-up, though a clear trend towards less avoidance and fewer intrusive thoughts was visible [7].

Finally, in 2003, Rothbaum et al. released another case study. The PTSD patient reported re-experiencing traumatic memories related to Vietnam while in the virtual environment, including some memories over which the patient felt guilt for his actions while in Vietnam, which is unique in that such patients are frequently not regarded as good candidates for exposure therapy [13].

Research has also been conducted for trauma derived from experiencing events such as terrorism. A promising case study conducted by Difede and Hoffman in 2002 discussed the progress of a survivor of the World Trade Center attacks of September 11, 2001. The female survivor was suffering from acute PTSD, and traditional imaginal exposure therapy had not been successful in reducing the patient's symptoms, including intrusive thoughts and inability to sleep. After six one-hour VRGET sessions in which the patient was exposed to scenes of the plane crashing into the WTC towers and the subsequent falling of the towers, the patient demonstrated an 83% decrease in depression levels and a 90% reduction in PTSD symptoms [14].

VR studies have also been conducted with motor vehicle accident (MVA) survivors. A study by Wiederhold, Jang, Kim, & Wiederhold (2001) found an 88% treatment success

rate in utilizing VR and off-the-shelf driving videogames to treat PTSD in MVA survivors. The treatment has also been successful for those who have a specific phobia of driving or who have a fear of driving as part of their panic and agoraphobia. In this study, participants exposed to VR showed both physiological arousal and subjective anxiety reporting that decreased as treatment progressed and desensitization occurred [15]. A study conducted by Walshe, Lewis, Kim, O'Sullivan, & Wiederhold in 2003 explored the effectiveness of a combination of off-the-shelf driving videogames and VR to treat PTSD in patients who had suffered an MVA. Fourteen patients experienced twelve one-hour graded VR exposure therapy sessions. A comparison between pre- and post-treatment states showed a reduction in self-report measures (subjective units of distress, or SUDS), Fear of Driving Inventory (FDI), Clinician Administered PTSD Scale (CAPS), Hamilton Depression Scale (HAM-D), and heart rate (HR), and also found a significant drop in travel distress, travel avoidance, and maladaptive driving strategies [16].

The Office of Naval Research has recently funded a study for development and testing of VRGET for those returning from Iraq. Though the study is incomplete, initial pilot testing indicates that VR produces both subjective (self-report) and objective (physiological) arousal in individuals suffering from PTSD. Initial data also indicates desensitization over time, with patients experiencing a lessening of symptoms and elimination of nightmares.

IV. CONCLUSION

When used appropriately, VR therapy can be a very effective treatment option. The number of investigators and studies continues to increase annually, with many new studies and applications appearing in the literature several times a year. The technology is advancing very quickly, bringing improvements such as graphics that flow more smoothly. Some investigators are seeking ways to provide VR systems through the commonly found game boxes of Sony PS2, Nintendo Game Cube, and Microsoft's X-Box. Methods for delivering virtual worlds over the Internet are also being developed.

Initial reports have shown VR technology to be a helpful therapeutic tool in the treatment of PTSD. Because it is not realistic to expose someone to the trauma stimuli in vivo, VR in the area of PTSD appears very promising. Although more research needs to be conducted, the results thus far show that VR therapy may decrease the length of treatment and may increase the likelihood of long-term reduction of PTSD symptoms.

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Integrated environmental monitoring and public health in Vietnam

Kevin Montgomery, Ph.D.

Intelesense Technologies

Abstract- Environmental factors and public health are inseparably linked. The effects of the air we breathe and water we drink has a profound impact on the health of individuals and societies in general. Recent studies have shown that up to 80% of human illness presented at clinics in developing countries are due to water-borne factors that are largely preventable. These countries also have limited resources for environmental protection and remediation and these resources must be managed very efficiently toward making the greatest impact with lowest possible cost.

We have developed a system of environmental sensors that transmit their data wirelessly in real-time to a central server. This server integrates public health data and other data sources automatically, and provides a real-time GIS-based Web-enabled display of linked environmental data and public health information in order to derive links between these factors and provide for an early warning system for infectious disease outbreaks (including bird flu), environmental damage, and generalized monitoring. This system has been deployed in a number of locations in the Asia-Pacific region (including California, Hawaii, and, most recently, Vietnam) and is being expanded currently.

I. INTRODUCTION

While the costs of the health effects of water-borne illnesses in the United States are conservatively estimated at $19B annually (other reports cite as high as $50B), the developing world is much worse off in terms of mortality. According to UN estimates, over 5M people die annually due to water-borne diseases, most of them children. It is also estimated that 60% of infant mortality worldwide is linked to infectious and parasitic diseases, most of them water-related. These outcomes are primarily due to significantly greater impurities and pollution in drinking water, the absence of reliable water treatment facilities, and inadequate or unavailable health care. Clearly, environmental factors and human health are highly interrelated. Therefore, there would be a tremendous impact on human health and infectious disease if we could leverage our existing on-line environmental monitoring system for the developing world. *[UN World Water Development Report (WWDR) 2002]*

The country of Vietnam has identified water borne illness as a serious problem of special political emphasis in the past year. Statistics from United Nations Development Program (UNDP) show that 80% of human illness in rural Vietnam is caused by water-borne disease or pollution. Also reported was that 46% of the country's 70 million people do not have clean water- this amounts to nearly 32 million individuals. Further, the role of Vietnam as an emerging strategic partner to the US provides a unique and timely opportunity for collaboration and public health is one area of mutual interest to begin building a relationship between the two nations. Linking environmental factors to disease outbreaks of emerging infectious diseases (such as avian influenza) would provide valuable information for rapid assessment and intervention.

This project is a unique collaboration between Intelesense Technologies, the Vietnamese Academy of Science and Technology (VAST), the Hanoi School of Public Health (HSPH), and the University of Hawaii (UH-JABSOM) to research linkages between changes in environmental parameters to human health and infectious diseases.

We have produced an advanced system for generalized environmental monitoring integrated with other data sources. As part of a research project with the Telemedicine and Advanced Technology Research Center (TATRC), Intelesense is producing a system for establishing links between ecosystem parameters and human health. The developing world has serious public health issues from contaminated water sources and Vietnam in particular is keenly active and aware in this area, making it a national priority. While the impact of environmental monitoring on public health would be tremendous in any developing country, the importance of Vietnam, and the focus on water quality as a national public health priority, makes it uniquely appropriate for this project.

II. COLLABORATIVE PARTNERS:

No significant endeavour would be possible without the individual hard work and strong collaboration between cooperating and trusted partners. Toward that end, on this highly collaborative and integrated project, we first present the cooperating institutions in this project.

Intelesense Technologies: We are developing an extensive real-time environmental monitoring system that is real and deployed in a number of locations in the US. This system monitors water and air quality, and links to other databases of other information to provide real-time analysis and GIS-based secure access to information.

Intelesense has also been working heavily with the University of Hawaii to develop an environmental/ecological/infectious disease monitoring system. This system consists of water and air sensors, together with animal tracking, to establish links between the ecosystem and environmental parameters, ultimately to produce a computer model of these factors related to human health. This project is being funded through multiple partners including the EPSCoR project funded by National Science Foundation (NSF), the Pacific Telehealth and Technology Hui, and private donors. It has served to greatly further technological development in this area. With the addition of public health data in Vietnam, the previous work done on this project will be heavily leveraged for the Vietnam project.

Vietnam Academy of Science and Technology (VAST): This academy is the main science and technology research arm within the country of Vietnam (equivalent to the NIH and NSF in the US), and has expressed strong support in collaborating with the UH and Intelesense on this project. They will provide considerable expertise and collaborative support regarding the Information Technology (IT) connectivity and infrastructure to support the sensors used in this pilot project.

Hanoi School of Public Health (HSPH): The public health emphasis in Vietnam is of increased importance in Vietnam, as it faces preventive health issues on many fronts. The Hanoi School of Public Health is the only school in the country of Vietnam providing both undergraduate and graduate degrees in public health. The Dean of the School has expressed considerable interest in partnering with Intelesense and UH on this project, as it can be readily leveraged into other existing pilot projects involving disease surveillance.

University of Hawaii, John A. Burns School of Medicine (UH-JABSOM):

UH is a current partner in the Hawaii project, and they have a strong understanding of how this project can be deployed in Vietnam. The School of Medicine's partnership encompasses both infectious disease expertise and telehealth (IT) expertise. The Asia-Pacific Institute of Tropical Medicine and Infectious Diseases has strong ties with Vietnam through the Ministry of Health. The Division of Ecology of Health that is providing support on the current Hawaii project is now part of this Institute. The Telehealth Research Institute, also part of the Hawaii project, also has developing ties to Vietnam. Both UH Institutes have growing ties with VAST and the Hanoi School of Public Health, and they recently hosted the Director and Dean respectively in Honolulu, and were hosted in Vietnam during the past two months. UH has also developed a strong working relationship with the US Embassy Health Attache who is supportive of this collaborative research effort. These strong collaborative relationships will be further developed through this Intelesense research project.

III. MATERIALS AND METHODS

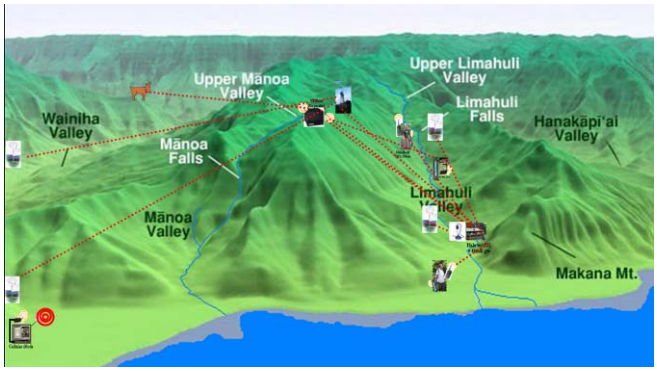
Prior Work:

Overview: We have developed an advanced, integrated detection, analysis and display system for environmental monitoring and a myriad of other uses. The system consists of advanced sensors (both long-term, broad spectrum physicochemical change detectors, as well as advanced specific biosensors for targeted pathogens) that are connected to a small, self-powered computing device. This device reads data from the multiple attached sensors and transmits its data wirelessly to a base station computer. The radio link is capable of transmitting for 14 miles (depending on conditions) and, by routing through other nodes, can extend the sensor network for tens or hundreds of miles, even in steep terrain. Additionally, the same network supports voice communication over the deployed area as well. An advanced proprietary algorithm enables these systems to transmit and route data with extremely low power consumption, enabling our devices to be small and completely self-powered.

Once data is received from the many remote sensors into the base station gateway computer, it is uplinked over the Internet (via DSL, satellite, or any other media) to our central server. This server takes in data across all sensors from all deployments, and can also extract data from other online sources (other web sites, other databases, other systems) and integrate this data together with the sensor data. In this way we can easily integrate the sensor data with public health data or other databases very easily. While each individual data source (sensors, public health data, media information) may provide only a limited view of information relevant for detecting emerging disease or environmental damage, the integration of data across multiple data sources provides for an extremely robust system for the detection of such events.

This system is real and has been deployed in some of the most remote and rugged terrain available. Our initial testbed for this technology was literally the wettest place on earth-central Kauai, Hawaii. This area, in addition to having over 450 inches of rainfall per year, also consists of steep canyons, no cellular coverage, accessibility only by helicopter, and other technical challenges. Our intent was to prototype and refine the system in this deployment area with the goal of making all future deployments in other areas much easier by comparison.

Here is the network map for the deployment on northern Kauai- the water sensor devices, bouncing its data off the repeater on the Manoa ridge, to be received by the gateway computer at the research station and forwarded over the Internet to our server:



The system also integrates directly with 5 weather stations located in each valley and Manoa Ridge, transmitting via repeater. In addition, this deployment supports live video and mobile field researchers and even animal tracking using the same system, using an internal GPS receiver.

The live data of water quality parameters (pH, ORP, conductivity, temperature, dissolved oxygen and turbidity), weather data (including rainfall, temperature, humidity, wind speed and direction, and light intensity), along with the video sources, tracked animals, and field observations are all integrated with GIS-based maps into a secure website. In this display, there were icons for each of the sensors which, when selected, displayed an image of the sensor in place and provide its most recent data, including graphs of sensor parameters and their distribution, normalized correlation and deviation from baseline, etc. Video sources provide a live video image from the camera. Field observation icons present a stored web page of the field observation report. All information was intuitively presented, accessible in real-time and secure.

Technology: The system we developed consisted of the sensor computer connected to the RF radio module and built into a ruggedized case, together with a large battery and rugged external connectors for antennas, solar panel, and sensor. This computer could then transmit its data, perhaps via other nodes, to a central base station that receives the packetized, secure data and uplinks it to the central server over the Internet. Photos of some of these water sensors are provided below:

In the very deep valleys of our testbed location, we need the capability to have a signal repeated from one remote sensor area in one steep valley to the next. We therefore integrated voice and data repeater functionality into the devices that could be deployed on the top of these steep ridges and, when a sensor on one valley would transmit, the repeater node would get the signal and repeat it into the next valley. By also deploying repeater stations, our sensors can be deployed literally anywhere by extending our radio coverage zones. Our system is now even more robust and our coverage zone can be extended for tens of miles or more, even in the steepest and most rugged terrain.

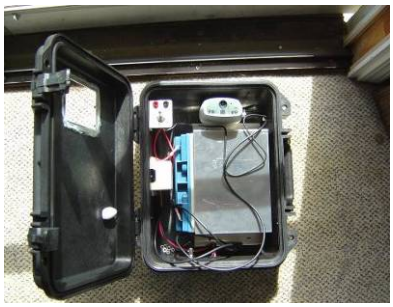
We produced these integrated, solar-powered voice-data repeaters and deployed one on the ridge-top (a knife-edge ridge at 2000 ft and 10 feet across, barely accessible even by helicopter) at our testbed site. Photos of the repeater stations are given below:

So, to summarize, we've developed a robust, ruggedized RF-based voice and data network with sensors that are self-powered (solar) and able to be remotely deployed just about anywhere. In addition, through careful implementation of the repeaters, the same system can be used for voice-based transmission using commercial-off-the-shelf (COTS) portable radios. All of these features together mean that we can deploy sensors and people anywhere over an extendable network of tens (if not hundreds) of miles.

IV. VIDEO TRANSMISSION:

Besides voice and data transmission, a robust system for sensing and biosurveillance also may need the ability to send imagery from remote locations as well. Since the network above is primarily for low-bandwidth applications and, to save funds at this early stage of the project, we developed (from COTS components) two different remote, self-powered, video surveillance sensors as well.

The first was a GSM-based cellular camera can capture images at regular intervals or upon sensing motion, then transmit this image as an MMS image to either our central server, or directly to an MMS (picture)-enabled cell phone. On the left below are the internals of the cellular surveillance camera- on top you see the camera itself, below that the large battery, and to the left the power circuitry which interfaces to an external solar panel (not shown). Below you see the camera as deployed in its ruggedized, sealed container.



Finally, we also developed a remote, self-powered wireless camera using a pan/tilt/zoom Toshiba ruggedized outdoor camera assembly, and a custom developed battery box with solar recharging capabilities. This camera was mounted on the side of a remote, unpowered utility shed halfway up the lower Limahuli valley, providing it with a view of the entire lower valley all the way out to the ocean. This camera is displayed below:

While these initial attempts at using COTS (commercial off-the-shelf) components demonstrated the utility of having remote imagery, their implementation also showed that traditional, existing products will not be sufficient for providing long-range remote video imagery in the more remote parts of the valley. Instead we will need to investigate the production of a low-power, custom imaging device that could use our repeater-based network and thereby provide access to anywhere in the valley as a future project. Providing imagery from the most remote locations of the valley will enable many new capabilities such as animal observation, remote diagnosis of equipment failure, and the ability to experience the most remote sections of the valley virtually.

V. HANDHELD GPS-BASED LOCALIZATION SENSOR DEVICE:

In addition to all the features (voice, data, and video sensors, repeaters, etc), we also always found the need to locate our sensors and other equipment in the field. This is required in order to place the icons on the GIS-based maps in the correct location.

We have developed a prototype, integrated GPS inside of our sensors, repeaters, and other equipment for future deployment. The sensor, besides sending the sensor data, also sends the current GPS coordinates of the sensor over the network. The database then received and stores this information and the display dynamically and in real-time draws the icon for the sensor in the correct location.

The implications of this additional functionality are many. First, now when a sensor or other equipment is deployed, it need only merely be turned on and its data and location will be sent automatically- no additional steps are required. In addition, sensors can now be mobile- a field researcher can use a handheld device and take samples at different locations and these will be saved. In addition, mobile (perhaps vehicle)-based sensors are now supported. Such a system would also be useful even just as a means to relate the positions of equipment and personnel (for example, in the case of first responders or other workers), integrated with the environmental sensor data stream. And now all sensors are displayed on the GIS map dynamically and, should a sensor be moving, we should see the icons tracking on the screen and provide for location of the individual or sensor. This handheld device was delivered and successfully demonstrated as well:

Our intent is to refine this device to provide an easy mechanism for sampling environmental parameters at any location, not just those fixed locations suitable for a permanent station. In this way, we can take water quality samples along the entire length of a stream or, by trailing the sensor behind a watercraft, easily sample an entire bay in an afternoon.

Summary: In short, we have developed, deployed, and successfully tested an advanced voice-data sensing network in one of the most rugged terrains available. This system transmits water, weather, video, tracking, and other data over our custom network, through repeater stations, to a gateway computer where these data are uplinked over the Internet to a central server. This server then integrates all sensor data with data automatically pulled from other sources (other weather data sources, vegetation information, etc) and displays this data on a secure, GIS-based website, enabling collaborative display and dissemination of information.

VI. CURRENT WORK:

While the system above may be, in the words of an NSF program director overseeing the project, “the most advanced environmental sensing network in existence”, our goal is to make a greater impact than just in the area of ecological research and environmental remediation. Therefore, we began investigating the use of the system for water-borne illness in developing countries such as Vietnam. Since 80% of human illness presented in health clinics is related to water-borne factors, our desire was to use our system to similarly impact human health in Vietnam.

Toward that end, we visited Hanoi in October 2004 to meet with the heads of the Vietnam Academy of Science and Technology (Prof Minh) and the Hanoi School of Public Health (Dr Anh), together with collaborators from the University of Hawaii School of Medicine (Drs Burgess, Wilcox, and Gubler), and facilitated by TATRC (Dr Mogel). It became rapidly clear that water-borne disease and pollution effects on human health in this region were significant concerns and the timing and enthusiasm was ripe for producing a project in this area.

We returned in February 2005 to outline a joint proposal to address this significant concern. It was on the

basis of these discussions that this proposal was produced. The initial plan is to undertake a limited deployment of sensors in the Tien Hai township in the Thai Binh province, roughly 3 hours southeast of Hanoi. This region was selected due to its known issues with water quality and the availability of public health information and resources in the area. Sensors would be deployed in the water system (such as the water storage tower depicted at right) to look for changes that may indicate conditions conducive to water-borne pathogens.

Information from the sensors is presently integrated with public health information provided by the district health offices in the area, which enters syndromic surveillance data and other public health parameters directly into our system via a Web-based interface. The goal is to demonstrate, in a limited deployment, a suite of environmental sensors integrated together with public health information. Secondary benefits include the availability of real-time public health data from outlying clinics (these clinics currently produce monthly summary reports, which is too late for rapidly spreading emerging infectious diseases. This proposal addresses these goals as an early pilot project for demonstrating the utility of integrated environmental-public health monitoring.

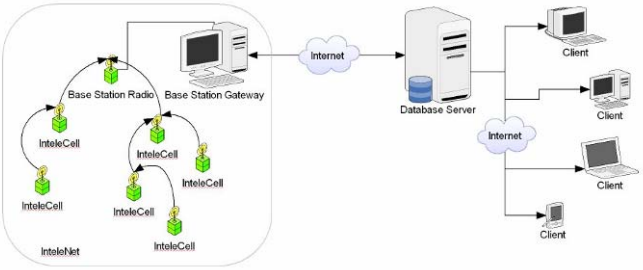
VII. TECHNICAL RESEARCH AND DEVELOPMENT:

As part of our collaboration with the University of Hawaii's National Science Foundation (NSF) environmental monitoring project, we are currently developing a next-generation of the system outlined above. The research and development costs of this next-generation system are provided as part of the UH-NSF project and will be leveraged and deployed for this proposal for Vietnam.

Briefly, all aspects of the system previously presented (in the Prior Work section) have been completely redesigned, enhanced, and improved in every way. Our new sensor device uses a new processor; different and much greater capacity memory (now up to 4GB for imagery/video storage); has expanded I/O capabilities (multiple serial and analog interfaces, external power control) with internal expansion using modular daughterboards; smaller battery and solar panels; lower weight; new case design; and smaller size. In short, in every way, this is a new and much more advanced device that is easier to deploy, more robust, expandable, and more capable than the old system.

The firmware for these devices is completely new as well-written in a high-level language to make programming much easier and faster to develop. New capabilities include using an improved protocol for transmission, advanced reporting features, and the ability for remote updates of firmware, over the network, from anywhere on the planet. In this way, once our systems are deployed, we can continue to upgrade them even in the field from our labs halfway around the world, providing a future-proof solution and improved maintainability.

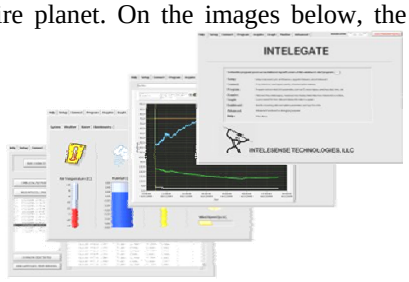
As far as wireless transmission, the next-generation system uses different, new, lower-power radios. The new system produces a self-configuring, self-routing mesh network, with each sensor device acting as a repeater for other nodes in the mesh network. Through a novel, proprietary algorithm, our system avoids the increased power consumption typically associated with these types of networks and provides routing functionality at extremely low power consumption. Moreover the network is self-repairing- if nodes become unavailable, other nodes within transmission range will take over to insure that the transmission of data continues to propagate thereby using redundant sensor nodes to increase the robustness and reliability of the network.



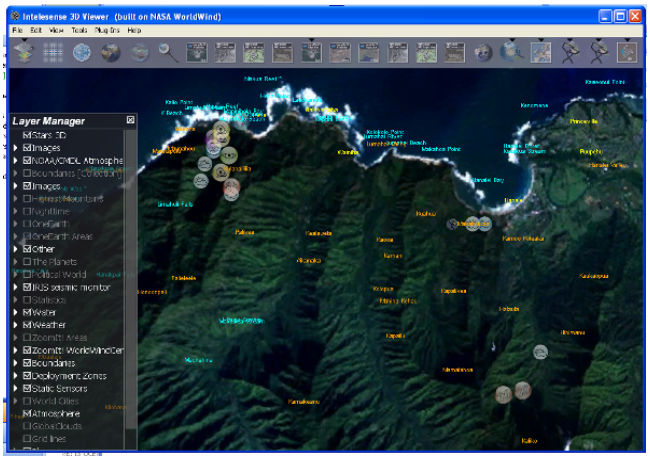
The base station software has been completely redeveloped as well- providing for local configuration, display, and control, but also providing for remote, network-based access to any node in the system. The central server is also being completely reengineered at this time to provide greater flexibility and greater capabilities to integrate data from any source seamlessly.

Finally, and perhaps most exciting, we are currently developing a completely new, 3D display system that allows us to "zoom in" to anywhere on the planet and pull down many different types of satellite imagery from servers located anywhere over the Internet. We can tilt down and fly around the terrain, investigate line-of-site issues, examine topological changes and their potential impact, and integrate many data sources into the same, interactive 3D world. Our initial prototype of this system is currently operating and images are provided below.

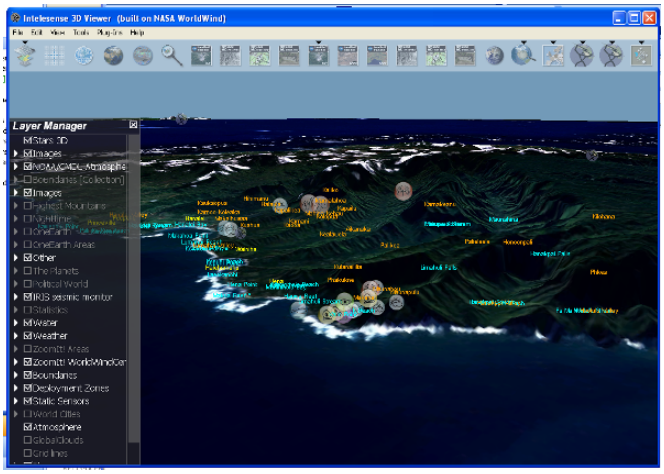
In these images, you see the map of the Limahuli (north Kauai, Hawaii) deployment zone and the user can interactively fly around the terrain, zoom in to see small features, or zoom out to see larger terrain, the island as a whole, or even the entire planet. On the images below, the map of this deployment zone has icons depicting our water and weather sensors, tracked animal collars, wireless video cameras, as well as



other equipment that has been deployed (such as a repeater node and the base station). The user can click on any icon to pop up an interactive web page showing the sensor information (photo, sensor type/info, calibration information, etc), as well as the live data (sensor values) and charts for trend analysis.

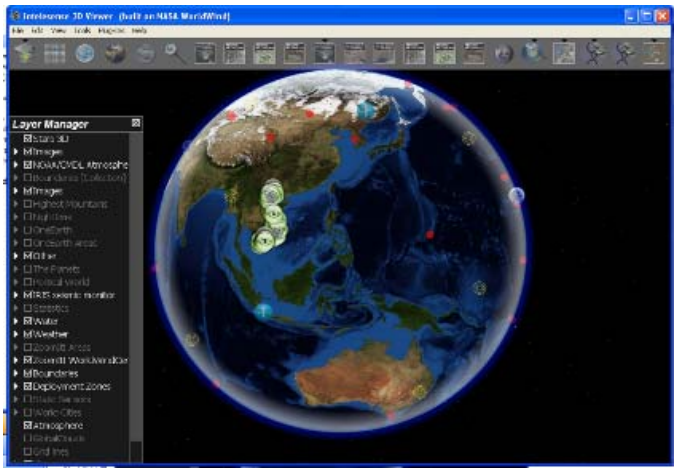


We now can tip down our view to fly through the 3D terrain of the valley in real-time and view the valley from a point overlooking the ocean.

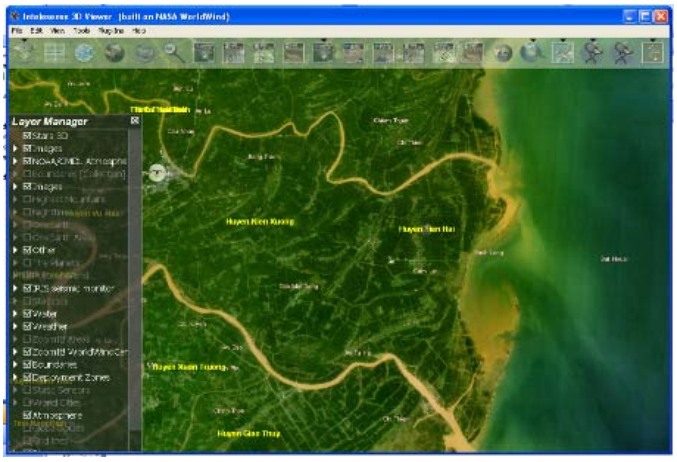


It is important to point out that our new visualization tool works, literally, for anywhere on the planet and pulls the highest resolution satellite or aerial imagery available for that particular region. In this way, we can deploy our sensors anywhere on the planet and immediately have real-time visualization of the location and full interactivity with the sensors automatically, within minutes.

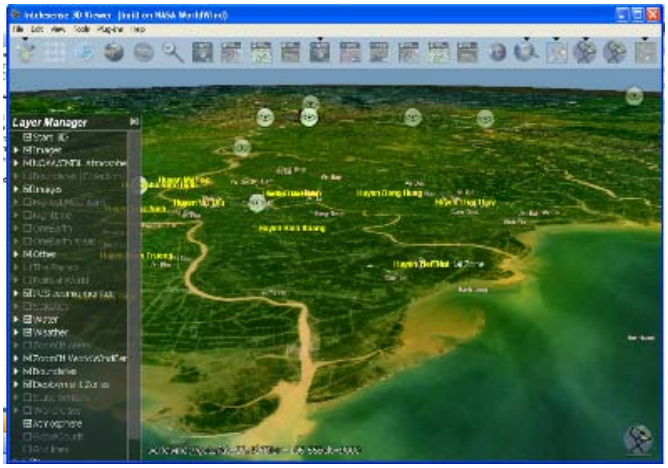
To demonstrate this, we can start our system out over the Pacific, then zoom into Vietnam at an altitude of 4500km:



From here, we can zoom into Tien Hai at an altitude of 36000m and the system will automatically read in the highest resolution satellite imagery available for that region. We can also turn on known landmarks for the region:



And finally, tilt our view down to fly around the terrain:



This powerful visualization tool allows us to bring up any location on the planet and overlay our own sensor data, as well as data from public health reports and any other data sources available. This *integrated georepository* is a

powerful and effective tool in understanding environmental damage, public health trends, and emerging infectious disease patterns.

CONCLUSION

We have developed, demonstrated, and deployed technologies for real-time environmental monitoring. This distributed system consists of a wireless network of smart sensors (water, air, video, etc) transmitting to a central server that integrates this information with that of other sources (such as public health data and disease surveillance data) to perform real-time analysis, alerts and secure GIS-based display. This system is extremely useful for generalized environmental, public health, infectious disease, and bioterrorism-related monitoring.

ACKNOWLEDGMENT

The authors gratefully acknowledge the tremendous support of the Telemedicine and Advanced Technology Research Center (MRMC), and that of our collaborative partners, including the Vietnam Academy of Science and Technology (VAST), Hanoi School of Public Health (HSPH), and the University of Hawaii.

TATRC International activities

J-L Belard, M.D

Abstract-Since its very start, the Telemedicine and Advanced Technologies Research Center (TATRC) has been involved in the deployment of telemedicine capabilities in different parts of the world.

In recent years, TATRC has diversified its international objectives well beyond providing technological solutions to countries in need. Through its active participation in yearly international professional meetings, the establishment of a West Coast and a European presences, along with a continuing effort in developing and nurturing person-to-person relationships, TATRC has now reached a position of world-renowned reference center in the field of advanced technologies applied to health. TATRC's international impact can be seen in three major directions:

1/. Financial support of research projects proposed by foreign scientists,

2/. Organization of a yearly fellowship program for foreign military or civil servants involved in telemedicine programs, and

3/ Coordinate an International Day every year coupled with the American Telemedicine Association annual meeting

Through such efforts, TATRC has now established very strong ties with several countries in all continents. We all have a better understanding about our partners strengths which will avoid redundancy in our research programs which translates into a waste of ressources. Developing this type of close and fruitful relationship with foreign colleagues leads to a much better management of financial ressources.

Our presence and our support to Med E Tel is another proof that although we are proud of our achievements, we know that we need to cooperate with our foreign colleagues, so that we all can participate in reaching a common goal: meet the medical challenges in an ever changing world

I. INTRODUCTION

In recent years, TATRC has succeeded in establishing an outstanding network of partners in industry and academia throughout the United States. As a result of this collaboration with top universities and industry laboratories, TATRC is now recognized all over the country as a reference center for the identification, evaluation and delivery of medical advanced technology. Shortly after its creation in the late nineties, it started to look beyond the US borders to initiate collaboration efforts with researchers in other countries. Most of them have finally recovered from the condition called the "not invented here" syndrome. As opposed to the past, when it was almost inconceivable to use a device not specifically designed for a specific population, economic and practical reasons have forced us to realize that it would not be wise to spend fortunes in research and development when the product we look for is already available somewhere else.

In 2000, the position of International Chargé d'Affaires was created to aggressively pursue an international effort in every direction and to overview a growing international portfolio. Five years after, through a palette of actions described below, TATRC has strengthened its international reputation in many parts of the world. In order to meet the medical challenges of the near future, our organization establishes cooperation agreements based on co-funding, funds international projects, lends equipment for evaluation, continually watches technology progress, trains foreign colleagues and organizes or sponsors international meetings.

A. FINANCIAL SUPPORT

TECHNOLOGY WATCH

Considering our budget and the number of projects that we manage, TATRC is a rather small organization which employs 70 people including 35 involved in project scientific management. This is our first line of tech watchers. Most of our project managers hold a medical degree, a Ph.D. or a master's degree. All are specialized in technical areas such as medical simulation, robotics, distance learning or telesurgery to name just a few. They are in permanent contact with their peers in the US or abroad, and are recognized as subject matter experts in their field. Through their own network, and their participation in scientific meetings, they keep informed about new trends or findings in their field, which they share with their TATRC colleagues on an ad-hoc basis.

International technology watch also relies on other means, such as our presence abroad, an office on the west coast of

the United States, and active participation in an international scientific group based in Washington. Our prescence abroad is more than 3 years old: TATRC has a permanent representative in Brussels whose medical military background is very helpful especially in our relationship with NATO. He is the co-chair of the NATO Telemedicine Panel, and as such he maintains an open line with our allies, and attends many NATO technical meetings in Europe. In addition, since the TATRC European office is in Brussels, our representative keeps in touch with and exchanges information on a regular basis with the telemedicine specialists within the Health unit of the European Commission and other important agencies in Europe such as the European Space Agency and the International Telecommunications Union.

In addition to our representation in Europe, TATRC opened last year a West Coast office based in Los Angeles. In addition to maintaining close contacts with our academia and industry partners in the Western part of he US, this new office is developing fruitful relationships with countries in the Pacific Rim and South East Asia, and specifically with Japan, whose expertise in advanced technologies is recognized all over the world.

As a former Defense Medical Attaché with the embassy of France in Washington, the TATRC International Chargé d'Affaires is also a member of the Diplomatic Science Club (DSC). This club is open to all present or honorary science and technology counselors or attachés of embassies in the District of Columbia. The DSC organizes visits and contacts with the science and technology offices of the State Department, the White House, the NASA or the Academy of Sciences to name a few. Through this very important scientific and political network, TATRC may gather critical information regarding short to mid-term trends in advanced medical technologies in the world.

COOPERATION

Cooperation with foreign countries can be envisioned in two different ways: either TATRC co-funds a project with a foreign nation or institution, or it can support projects entirely. The first co-funded project was with the kingdom of Norway and this joint effort is still active today. This cooperative agreement focuses on the evaluation of the patient tracking system using electronic "dog tags" such as the Personal Information Carrier (PIC). Since Norway already has a very robust telemedicine infrastructure, it is critical to evaluate the connectivity of the PIC in such a system. France is another country with which TATRC has a joint effort. The French medical corps is co-funding an effort on vehicle to emergency room data transmission. The equipment will allow the transmission of medical data from the ambulance to the hospital receiving station, which would monitor in real-time the patient's vital signs before he reaches the hospital. This package will be evaluated during evacuation of trauma patients.

Besides these co-funded efforts, TATRC also financially supports research programs in other countries: in cooperation with Yuma Proving Ground and the University of Arizona Health Sciences Center, a pilot research program on cervical spectral imaging has started in Panama to evaluate how telemedicine could improve the accuracy of disease detection, along with the availability of clinical expertise . In Argentina, through collaboration with the Philadelphia-based National Bioterrorism Civilian Medical Response Center (CIMERC), we supported a project to make biodefense information readily available in Spanish through Internet to health care professionals. In Nicaragua, a project with the Center for International Rehabilitation of landmines victims was aiming at improving the availability and fit to amputees of artificial limbs . In Poland, two of our former students are now in charge of establishing a dedicated telemedicine network between Polish troops in Iraq and the military medical academy hospital in Warsaw. In Pakistan, in collaboration with the State Department, two of our former interns are developing a telemedicine training program for doctors and nurses and setting up a Pakistani telemedicine association. We have also several projects with other countries or international organizations which might come to fruition in the near future.

FUNDING

A company or university laboratory may get TATRC funding by going to our webpage (www.tatrc.org). Hitting "proposals" on top of the page leads the investigator to the Proposal Submission System. Upon reading the documents included in the Broad Agency Announcements (BAA), prospective candidates for funding will get information on specific Army needs. They can submit a pre-proposal which responds to these interests. If prospective investigators think they might have a novel approach to a problem of potential interest to TATRC which is not listed in a BAA, they can submit an unsolicited pre-proposal. In both cases, the pre-proposal is then reviewed by a subject matter expert, who presents the pre-proposal along with his/her review and recommendations to the Proposal Review Board (PRB). The PRB is a group of TATRC personnel which includes MDs, PhDs, MBAs, Program Managers and Officers among others. The PRB meets almost every week and reviews between 10 and 20 research projects per session. The competition for funding between pre-proposals is severe since the approval rate is around 10%. The PRB then transmits its recommendations to the Director of TATRC. Upon approval from the Director, candidates may submit a full proposal, with detailed information on the research protocol, the budget, the deliverables, keeping in mind that a request for full proposal does not mean that the project will be funded.

Aside from interesting proposals which might not be supported only because of lack of available funding, others may be rejected for three major reasons. The most obvious one is that authors failed to show the potential benefit for the soldier, or more generally the relevance to the TATRC

mission. The second is that the budget might be inflated, or the research approach, hypothesis or study protocol are not satisfactory. The last reason for rejection might be that the proposal is redundant with research programs already funded by us or other agencies. All these rules regarding a direct effect benefiting our soldiers, sound scientific approach, and non-redundancy to other ongoing efforts apply to foreign proposals as well as to those arising from within the United States. But in addition, proposals originating in foreign countries need to show some genuine interest from their own government or institution, in the form of a letter of support or even better, of participation in the financial support of the project. A proposal showing a substantial co-funding has much better chances to be recommended by the PRB for approval by our TATRC Director. Another important issue is the protection of human subjects and the proper use and care of animals in research. It must be understood that any research project involving TATRC funding which has animal-use or human-use implications has to be approved by our local Office of Research Protection. We will see in the following paragraph how that supports cooperation with foreign countries

B. TRAINING

In 2003, TATRC was asked by Pakistan's Minister of Research how young doctors could receive some training in telemedicine and advanced technologies. This request led us to design a 4-week orientation course in telemedicine to allow students to acquire a complete vision of what state-of-the-art telemedicine is all about. The program is based on a comprehensive mix of presentations and visits to partner facilities throughout the United States. Foreign governments or organizations can send promising individuals who upon return would themselves take the lead in this field in their own country. As a result of this training, two young Pakistani doctors are now starting to run a telemedicine training program based on distance learning technologies. The same is happening with Poland, which sent us last year a cardiologist and a surgeon who are starting to design a telemedicine network centered on a major military hospital. TATRC does not charge anything for the course, however foreign governments or organizations are responsible for all travel and living expenses of their students while attending the training..

There was no course in April 2005 but it looks like the 2006 session is in demand. Countries such as South Africa, France, Colombia and Nigeria have already expressed an interest in sending two or more students next year. Although the 2006 curriculum has not been finalized yet, the program follows the same general format every year. It lasts 4 full weeks (Monday to Friday) and ends with the annual American Telemedicine Association (ATA) meeting. The ATA always starts on a Sunday afternoon and the preceding Saturday is devoted to our TATRC International Day, which will be described in detail in a following paragraph.

The first week give the participants a vision of TATRC's mission, organization, and budget, and goes into the details of the different divisions' specific roles along with a comprehensive description of their research projects portfolio. The remaining weeks are devoted to visits in our partner's facilities. The second and third weeks focus on the Washington area and allow our students to visit our major partners in the National Capital area. Students will visit and receive lectures at the National Capital Area Medical Simulation Center (http://simcen.usuhs.mil), the Uniformed Services University of Health Sciences Center for Disaster and Humanitarian Assistance Medicine (http://www.cdham.org), the National Library of Medicine (http://www.nlm.nih.gov/) and the Georgetown University Imaging Sciences and Information Systems (http://www.isis.georgetown.edu). In addition, they will visit the Office of Science and Technology of the US State Department. The third week, they spend 2 days in Boston and meet our colleagues from the Center for the Integration of Medicine and Innovative Technology (www.cimit.org), then will visit Saint Francis University Center of Excellence for Remote and Medically Under Served Areas (www.cermusa.org) and come back to Washington to visit the Defense Advanced Research Projects Agency's Defense Sciences Office (www.darpa.mil/dso). The last week's program will be designed by our west coast TATRC office and will allow students to visit laboratories from University of Southern California, University of California Los Angeles, the University of Arizona Tucson, or Loma Linda University, all of which have programs funded through TATRC. Then our students are invited to attend the TATRC International Day and the ATA annual meeting during which they receive their certificate.

C. INTERNATIONAL MEETINGS

Through sponsorship or active participation in professional meetings at the national or international levels, TATRC strengthens its relationships with existing partners, but more importantly creates new ones. The annual ATA meeting has been for the past ten years a major event in the telemedicine world. Thousands of attendees can not only interact with each other andattend presentations, but also can meet with hundreds of exhibitors. The annual ATA meeting always opens on a Sunday and for the past 4 years, TATRC has been organizing an International Day on the previous Saturday. This event focuses every year on a different geographical area: Asia was the focus in 2005, preceded by Eastern Europe, Latin America, and Africa in previous instances. The TATRC International Day is a one-day event which allows scientists from a given region to share their telemedicine experience in front of an audience of 200 people and a 6-person expert panel. The format is now always the same every year since it gives enough time to present cases, discuss with the audience and get feedback from the experts. Four major themes are discussed during the day, two in the morning and two in the afternoon. Each theme is illustrated by 2 speakers' presentations, followed by a question and answer session. Both morning and afternoon sessions end with the comments of the panelists. This meeting has proved

to be very productive over the years since most of our current international cooperation efforts have been triggered by this particular event. During the 4 days of the ATA meeting, TATRC's international networking activities continue not only with our participation in the ATA International Interest group but also with numerous side-bar meetings with foreign representatives.

Medicine Meets Virtual Reality (MMVR) is a yearly January meeting in Long Beach, California. For almost 15 years, it has been a mandatory point of rendezvous for physicians, surgeons, and other healthcare professionals interested in emerging and future tools for diagnosis and therapy, educators responsible for training the next generation of doctors and scientists, computer and I T engineers who specialize in art imaging, simulation, robotics, or communication tools, and military medicine specialists addressing the challenges of warfare and defense health needs. The objective of this meeting is to present an international audience with state-of-the-art for medical simulation and its enabling technologies: haptics, tissue modeling, and simulation, emerging tools for clinical diagnosis and therapy such as imaging tools, data visualization and fusion techniques, and robotics, and intelligence networks for medical decision-making and patient care.

Med-e-tel is an international trade event and conference for e-health, telemedicine and information and communications technologies applied to health care. It takes place every year in Luxemburg and gathers attendees from all over the world, especially Europe and Africa. Due to the proximity with Europe, African participation in Med-e-tel is much stronger than in ATA. This event is supported by the International Society for Telemedicine and e-Health, and TATRC will have a presence at the next iteration in April 2006, to develop technical exchanges with European and African countries. A full one-day symposium will be planned to showcase not only TATRC's achievements, but our relationships with outstanding partners such as the National Library of Medicine, the United Nations, and the World Health Organization, along with top researchers from American university laboratories.

In conclusion, international activities are an important part of TATRC activities. The hard work of our staff is primarily focused at the well-being of our soldiers, but since they are deployed in many parts of the world, we must be aware of many different medical or technical approaches in response to a given situation. All program managers or officers are involved in this effort since they interact with foreign colleagues in almost every professional meeting. After achieving in the US the prominent position of the "de facto" reference center in telemedicine, TATRC is slowly but surely earning this well-deserved status among foreign colleagues. Through the funding of diverse foreign research projects, the training of foreign colleagues, and the yearly organization of an increasingly attended International Day just before the ATA annual meeting, our organization can be proud of our efforts in spreading beyond our borders American know-how in advanced medical technologies.

Session 2

Homecare and Health Management

Doc@hand, an innovative web based - ontology driven information access platform for healthcare professionals.

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Abstract - IST-508015 Doc@Hand is a project developed with the financial support of the European Commission aiming to provide to Healthcare professionals a powerful tool for a transparent interconnection of widely dispersed sources of information supported by a natural language query search feature. The platform also provides to users, in addition to a proactive, focused search of context-relevant search, additional 'pushed' information strictly related to personal user profile. Doc@Hand is a collection of modules, interfaces and protocols that perform common tasks and can be easily customized to match specific requirements of a given healthcare domain and user settings.

I. INTRODUCTION

One of the most important thing that each Healthcare professional has to deal everyday is a huge and widely dispersed various kind of information with multiple actors involved in the care delivery processes; on the other hand, the importance for professionals to collaborate, access and share data and knowledge has become critical.

Doc@Hand could support them in this context, by providing a set of software tools that help reducing time and associated costs to collect information and knowledge required and, more crucially, in making the best use of it for a more informed decision making (diagnoses, therapies, protocols).

Healthcare professionals could benefit by Doc@Hand in their day by day activities retrieving the needed information easily thanks to natural language text queries; results found can be displayed thanks to an intuitive interface able to easily filtering and navigating such information. The platform has been designed to allow user to easily connect through different terminals, such as desktop, laptop, tablet, pda etc. to support their mobility needs.

The results accuracy comes from an advanced Semantic Subsystem based on linguistic Parser and Ontologies (Top, Middle and Domain Level) plus a powerful xml-based search engine; such a mix of technologies leads to a dramatically increase of search results relevance.

In addition, Doc@Hand automatically creates a user profile accordingly to information such as user interests, last queries, last actions, etc; this allows, also thanks to the adoption of push technologies, to provide a lot of user-profile implicit relevant information dynamically without need for the user to perform an explicit query.

Doc@Hand is also integrated with legacy systems in order to extract other relevant information such as patient records (HL7 message protocol, a widespread standard, has been adopted), doctors' agenda, guidelines, etc.; it can also been integrated with other web applications and decision support systems. Platform architecture is based on web services, using XML standard for information representation; RSS standard has been also chosen to represent query results.

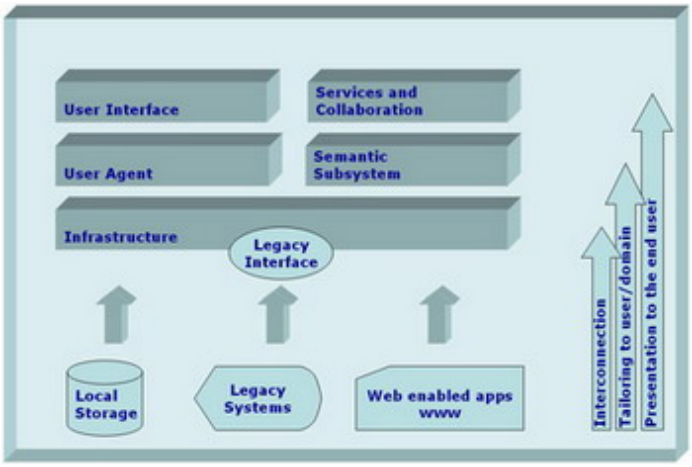

Figure 1. *System Architecture*.

II. INFORMATION PUSH AND PULL IN DOC@HAND

Doc@Hand is the first integrated healthcare software system to implement a combined content push, query pull and user profiling approach that is centered around individual users. None of these techniques are new per se, but they are new in this combination and in this domain.

Pulled content is data that is explicitly requested by the user, in the form of queries, and can be returned instantly (i.e. synchronously) or at a later time (i.e. asynchronously).

Quick free text queries to such as Google or Medline are an example of the former. More complex queries such as sending whole documents to the Doc@Hand semantic system, to find related documents, are an example of the latter.

Pushed content is data that is self generated within Doc@Hand with the aim of providing the user with content that they should know about, will find useful, and will be expecting to use. It is collated offline (i.e. the user does not need to be logged in) and is presented to the user at the start of their next session with the system.

Pushed data is partly comprised of the results of queries that run in the background that derive from a combination of the users history and of their explicitly.

Conceptually we can think of push, pull and profiling as being functionally distinct but in reality they are not. All pushed content is profiled to some extent and all pulled content will later become part of a profile and is likely to influence what is pushed. In the first Doc@Hand prototype, pulling of free text queries, documents and EHRs (Electronic Health Records) is supported. In addition, pushing of patient lists, of previous queries (text and document) and of query results coming from terms of interest in previously viewed EHR are all implemented. stated preferences. Doc@Hand contains domain specific ontologies that can be used to find conceptually related items to a previously queried term, whether entered as free text or found in a document. The system autonomously exploits this ontology so that it can push data that is related to these 'terms of interest' back to the user. The other aspect of data-push that we exploit is that the Doc@Hand furnishes the doctor, immediately at login, with the details of upcoming clinics.

III. Ethical Information Management

Sharing of clinical data is a great opportunity but also a challenge for the respect of the rights of patient's confidentiality and staff's intellectual property. In medical field, there is an increasing need and opportunity to integrate and communicate a large amount of data, referring to patients and diseases: that determines a massive phenomenon of data sharing among multiple actors and multiple organizations.

While this is a real opportunity for improving the care provision services, it also raises concerns for patient's sensitive and personal data and also for staff know how, for scientific property and even patents.

Protection of privacy depends mainly in having a secure system. Security requires that anybody accessing the system is properly identified and authenticated before he can be authorized to read or manipulate specific information. It is also crucial to properly define the boundary of protection. In networked computing, as it is common now, the boundary of protection is not simply the physical perimeter of a computer system, but is extended to all computer systems that share a common protection system.

Doc@Hand is designed to manage a large amount of sensible data in a secure way, respecting privacy and security.

We could say that privacy is the goal and security is the tool; it could be useful to consider both definitions.

Privacy is the right of individuals to keep information about themselves from being disclosed and to define who is authorized to access information and for which purpose; security is the ability of controlling the access to information and of protecting information from accidental or intentional disclosure to unauthorized people and from alteration, destruction or loss. Patients sensitive information are treated by respecting privacy policy; no data are stored locally, all EHR contents are managed entirely in memory as received from external sources, where it is protected by firewalls and other security provisions.

As EHRs need to be transmitted for processing, Doc@Hand provides two ways to prevent security risks: first, as secure protocol is used (https); second, EHRs are split in two parts (one for personal data and one for clinical data) and transmitted separately.

Thus EHR becomes completely anonymous and it is recomposed only after reception.

Additional security features are a strong user identification policy, with role based access to services and resources, and the implementation of an audit trail, recording and tracking any access to sensitive data.

IV. The System Core: Semantic Subsystem

Semantic Subsystem is composed by a set of tools strictly interoperating each others in order to basically provide two features: information/knowledge retrieval (clinical records, guidelines, clinical cases, protocols, scientific publications, etc) and information management (document submission, content parsing, knowledge mark-up, concept extraction, document indexing, etc…).

The following tools are the core of the Semantic Subsystem:

- Lucene, an Xml-based Search Engine able to analyse the user query submitted, to extract the main concepts, to expand the intended meanings leaded by semantic infrastructure (such as Ontologies). It interacts with the Ontology Server. It also retrieves query results and submits them to the presentation layer. Search Engine is responsible to analyse and perform queries pushing the extracted concepts both to internal Information Repository and to external data sources (i.e. Medline) and to return found results to the presentation layer.
- Protegé 2000, the Ontology Server responsible to communicate with all the other Semantic Subsystem tools in order to guarantee the access to the underlying information (Top Level and Domain Ontologies); a Domain Ontology defines the relationships between concepts annotated by domain experts to model a clinical situations. All Ontologies are written following the OWL formalism and can be navigated through an ad-hoc developed tool.

- Gate, the Semantic Parser responsible to analyse text documents performing concept extraction and mark-up (useful during document indexing).
- Information Repository Management System, an ad-hoc entirely developed tool that manages all documents submitted to Doc@Hand. There are basically two kinds of information managed: Documents Corpus (clinical guidelines, clinical trials, pathways, protocols, to be defined in collaboration with End Users) and EHR. The first document is physically stored on file system and indexed, the second one is entirely managed on memory due to private policy issue.

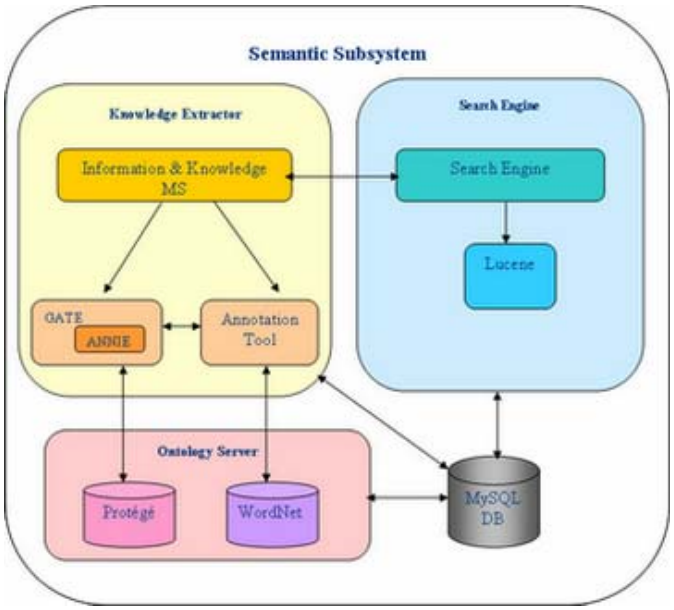

Figure 2. *Semantic Subsystem*.

In order to provide a more comprehensive vision about Semantic Subsystem, let's explain two main workflows describing each specific Doc@Hand use case.

Document submission

When a new document has to be added to Doc@Hand internal information repository, Semantic Subsystem needs to convert the document into plain text, then to segment document contents into tokens and sentences and finally matches them to corresponding entities defined in the Ontology.

Result of this process is a graph structure (semantic net), where nodes correspond to the concepts present inside the document.

Having identified all medical (and non-medical) concepts in a document, Semantic Subsystem ranks these concepts in order of their relevance (scores are on a scale of [0..1], with 1 representing the most relevant concept). The resulting document is an XML file where relevant concepts are tagged.

In order to provide a relevant amount of information, it is required to add a Document Corpus relevant for the specific domain (i.e. colon cancer) to Doc@Hand internal Information Repository; this operation can be done by a System Administrator through the following steps:

- Document selection; document should be typically a text/rtf/doc/pdf/html/xml type.
- Document submission; this action is a remote call to Semantic Subsystem WebService passing the document content as parameter.
- Content document processing; it includes actions like sentence tokenising, relevant sentence finding, sentences logical grammar analysis (NN,NL,NNS substantives, etc…), XML/RDF annotated document creation, semantic tagging (concepts found in previous steps are searched in Ontology in order to set the concept mark-up related to Ontology reference)
- Document indexing; domain relevant concepts marked by parser are used to create/update indexes and added to Information Repository both in RTF and XML format.

Query processing

Health professional needs to submit natural language query to Search Engine to retrieve specific issue information.

Then, each Doc@Hand user can manually type query text and submit it through the User Interface; this action invokes the Semantic Subsystem that:

- Analyses query content extracting relevant concepts (operation done by parser); such concepts are used to create the final query (enriched thanks to Ontology) to be submitted to Search Engine.
- Pushes the enriched query both to internal repository (Lucene) and to external information sources (Google, Medline, etc).
- Packages and prepares query results; relevant documents found are arranged into a single document and returned to User Interface as a documents links collection in XML (RSS 2.0) format.

This procedure is asynchronous; user can also retrieve afterward such results (user can select previous queries from a personal history list).

V. PILOT APPLICATIONS

In order to validate the application also in real world, Doc@Hand will be validated by two different hospitals in two distinct cases: Hospital Clinic de Barcelona (HCPB) will evaluate platform usefulness for colon cancer early referral, whilst Guy's and St Thomas' Hospital will apply multiple myeloma affected patient records to clinical trial in order to automatically screen the eligible candidates.

Early referral colon cancer

HCPB is the reference hospital of an urban healthcare sector of approximately 500,000 inhabitants; it has developed an ambitious program to explore the potential of innovative models for integrated care and Doc@Hand has been selected to support the screening and management of the colon cancer screening.

For this pilot, Doc@Hand has been customised to support:

- Effective screening at Primary Care;
- Prompt referral from Primary Care to Specialised Care;
- Follow-up (at risk group level) at Primary Care;
- Early diagnose & treatment at the Specialised Care;
- Consulting, guidance, support.

HCPB is currently testing the first Doc@Hand prototype;

pilot test session will over by April, 2006.

Patient trial matching

Guy's and St Thomas' (GST) forms a Joint Cancer Centre with King's College Hospital: the two Trusts offer a full range of services for the diagnosis and treatment of all adult cancers and it is involved in several Haemato-oncological disease trials.

The Doc@Hand pilot at GST is meant to support the NHS target of doubling the number of adult patients entered into trials bringing the number to at least 7.5% of all newly multiple myeloma diagnosed patients to significantly improve the UKs adult cancer survival rates.

One of the biggest barriers to recruitment is general awareness and understanding of the studies open to recruitment at site. Due to the number of specialist haematology registrars rotating through the department every four months it is often the case that they have not been introduced to the available trials when they see patients in clinics.

This results in possible participants not being recognised whilst they are eligible for entry.

Such scenario also impact in current everyday hospital problems, such as doctors rotations, overcrowded clinics, general lack of awareness of available trials and lack of resource for research nurses.

GST plans to use Doc@Hand to support a doctor suggesting all the available multiple myeloma trials suitable for a given patient, to maximise chances for each patient to be matched to all available trials without requiring encyclopedic knowledge by the Healthcare professional.

Multiple myeloma is an incurable disease: patients who achieve remission will, at some point, relapse, whilst others may not respond at all to conventional treatments, subject to more than fair share of clinical trials.

Thanks to Doc@Hand, each trial eligibility criteria will be automatically extracted, interpreted and applied to all the patient records: the outcome will be a matching score used by the doctor as a first patients screening. It will also be possible to see the electronic patient record and easily find out what laboratory test results mismatch the inclusion/exclusion criteria.

Nowadays, GST sees about 200 patients per year including around 50 newly diagnosed patients, but only a selection is currently screened by the research nurse: using Doc@Hand, a full 100% of patients screening will be possible thanks to an automatic patients screening for trial entry with a significant human time savings also assuring that all patients will have access to best possible treatments at all times.

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Electronic Monitoring of Dosing Histories Allows Real Time Detection of Poor Adherers and Offers the Bases for a Successful Intervention

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Abstract - We have just finished the assembly and begun the analysis of data on more than 16000 ambulatory patients whose dosing histories during studies of varying lengths have been electronically compiled (MEMS®, AARDEX Ltd.). These data come from clinical studies whose sponsors have concurred with entering their anonymized data into a common archive. Electronic Medication Event Monitors were used to record the times and dates of drug dosing during the course of >90 drug trials between 1990 and 2005. Chapter headings in the British National Formulary served to categorize fields of treatment. Study durations ranged from 30 to 1400 days. Patterns of deviation from prescribed dosing regimens varied widely, but were almost entirely markedly skewed toward longer dosing intervals than prescribed, i.e. under-dosing, in every field of treatment. In studies continuing beyond 12 months, almost 40% of trial participants had stopped taking the trial medication, despite a prescription that called for continued taking of the drug. Drug holidays (3 or more consecutive days without drug intake) occurred at least once a year in 50% of patients. Holidays occurred monthly in 2% of the patients, and quarterly in an additional 10% of patients. Underdosing, drug holidays, and early cessation of dosing are common features in ambulatory patients, and likely are frequent sources of low response and high variability in response to the prescribed dosing regimen. In practice, it thus becomes essential to identify, during the course of the treatment, the patients who make major errors in drug intake. The data base shows how electronic monitoring can be used to detect poor adherers and how a successful interventional strategy, based on reliable dosing histories, can be implemented to improve compliance and persistence with prescribed regimens.

Summary

We have just finished the assembly and begun the analysis of data on more than 16000 ambulatory patients whose dosing histories during studies of varying lengths have been electronically compiled (MEMS®, AARDEX Ltd.). These data come from clinical studies whose sponsors have concurred with entering their anonymized data into a common archive. Electronic Medication Event Monitors were used to record the times and dates of drug dosing during the course of >90 drug trials between 1990 and 2005. Chapter headings in the British National Formulary served to categorize fields of treatment. Study durations ranged from 30 to 1400 days. Patterns of deviation from prescribed dosing regimens varied widely, but were almost entirely markedly skewed toward longer dosing intervals than prescribed, i.e. under-dosing, in every field of treatment. In studies continuing beyond 12 months, almost 40% of trial participants had stopped taking the trial medication, despite a prescription that called for continued taking of the drug. Drug holidays (3 or more consecutive days without drug intake.) occurred at least once a year in 50% of patients. Holidays occurred monthly in 2% of the patients, and quarterly in an additional 10% of patients. Underdosing, drug holidays, and early cessation of dosing are common features in ambulatory patients, and likely are frequent sources of low response and high variability in response to the prescribed dosing regimen. In practice, it thus becomes essential to identify, during the course of the treatment, the patients who make major errors in drug intake. The data base shows how electronic monitoring can be used to detect poor adherers and how a successful interventional strategy, based on reliable dosing histories, can be implemented to improve compliance and persistence with prescribed regimens.

Main text

From clinical studies whose sponsors have concurred with entering their anonymized data into a common archive (Phamionic Knowledge Centre, PKC®.), we have accumulated electronically compiled drug dosing histories of more than 16000 patients in 10 major fields of

pharmacotherapy. Medication Event Monitoring Systems (MEMS®.) were used to compile drug dosing histories during the course of 90 drug studies performed between 1990 and 2005. Study durations ranged from 30 to 1400 days. Chapter headings in the British National Formulary served to categorize fields of treatment. The current data set results in more than 3.5 million days of compiled dosing histories [1].

Analysis of the above data set allowed us to identify 3 major components that comprise the concept of patient adherence to prescribed therapy [2]. When a prescription has been written, first the patient has to *accept* the recommended treatment. If the treatment is accepted, the patient then has to *execute* the dosing regimen. Finally some patients will *discontinue* treatment earlier than expected. Fig. 1 illustrates these components.

Two separate constructs allow one to describe and analyze those three components over time. The first one is *persistence,* defined as the length of time between the starting and the discontinuation of treatment. Persistence is thus a joint measure for acceptance and treatment discontinuation. The second construct describes the quality of the execution of the prescribed regimen while the patients are still engaged in executing the regimen. The measure of quality is the extent to which the patient's actual dosing history corresponds to the prescribed dosing regimen. In statistical terms, it is the comparison of two time series – the actual and the ideal dosing histories.

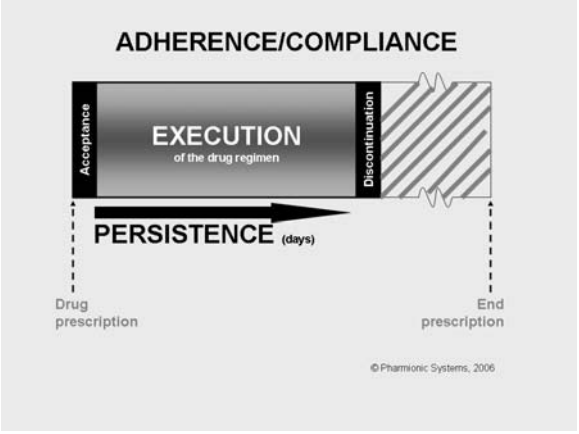
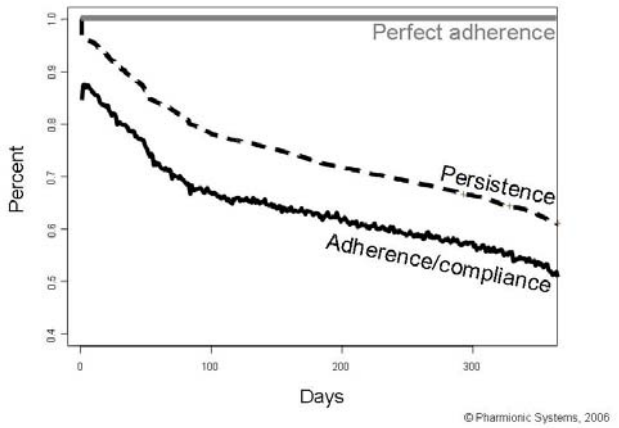


Figure 1. Schematic of the three phases of ambulatory pharmacotherapy. 'Adherence' is a blanket term covering any type of error. 'Acceptance' initiates the process; 'execution' characterizes the process; 'discontinuation' terminates the process. The length of time from beginning to ending of 'execution' is termed 'persistence'.

The constructs described in the previous section were applied to the data collected through the Pharmionic Knowledge Centre and are illustrated in Fig. 2.

Figure 2. Illustration of acceptance, execution and discontinuation in >16000 patients cohort collected through 90 clinical drug trials. See text for discussion of the data shown by the figure.



Patterns of deviation from prescribed dosing regimens varied widely, but were almost entirely markedly skewed toward longer dosing intervals than prescribed, i.e. under-dosing, in every field of treatment. The dashed line labeled 'persistence' is a Kaplan-Meier estimate of the fraction of the initial cohort of patients who are still engaged with the dosing regimen. Note the initial, sudden drop in the persistence curve, which represents the non-acceptors. The solid black line plots the fraction of patients who have dosed correctly on each consecutive day. The gap between the two black lines represents the shortfall in adherence due to poor execution of the dosing regimen. The area between the two lines is thus a measure of the quality of execution, defined for this exercise as the proportion of days with the correct number of prescribed doses taken. Depending on the pharmacokinetic-pharmacodynamic properties of the drug studied, other definitions could be investigated and perhaps found to be more apt. The gap between the hypothetical horizontal perfect adherence line and the dashed persistence line represents the lack of adherence due to early discontinuation. It is important to note that the magnitude of this gap is much greater than the magnitude of the gap due to poor execution of the drug regimen.

The 10 to 15% lack of adherence due to errors in execution should however not be overlooked. Delayed drug intake or missed doses can sometimes have major clinical consequences and probably sometimes play a role in treatment discontinuation. Burnier et al [3]. has shown that half of the failures with hypertensive treatments were due to poor execution of the regimen; the conception rate with low-dose oral contraceptives is 50-fold higher with 'typical' than with 'perfect' compliance with the once-daily dosing regimen [4]; with anti-infective drugs, poor execution appears to be a leading factor in the emergence of drug-resistant micro-organisms: the concentration of drug in plasma and tissues drops to a level low enough to allow the infecting micro-organisms' replication to resume, while still being high enough to create selection pressure for emergence of drug resistant micro-organisms [5].
A main problem in identifying such relations is that, with pre-electronic methods, 'quality of execution' and

'persistence' are hardly distinguishable and thus have been usually lumped together, creating a false impression that many patients who take only a third or half of their prescribed doses during a certain period of time have a very low quality of execution. Separating 'execution' and 'persistence' allows the explicit investigation of poor execution among patients who are still engaged in executing the regimen, and naturally focuses attention on short persistence, which has the larger clinical and economic impact.

With the advent of electronic monitoring, the topic of what patients actually do with prescribed drugs and its clinical consequences has recently become an inherently important research topic within the biopharmaceutical sciences, and is now known as pharmionics [6].

Recent research in this discipline [7, 8, 9, 10] has show that successful techniques for improving compliance and persistence require two key elements:

1. the objective, continuous electronic recording of day by day dosing times, which can be easily interpreted by most patients.
2. the continuing periodic review with the patient, by the prescribing physician, pharmacist, or nurse of the patient's ongoing dosing history.

The term for this approach is Measurement-Guided Medication Management (MGMM.), and is a clear break with past attempts to improve compliance based on unsatisfactory methods of measurement that depend on the patient's recall or timely diary entries and afford the patient the easy ability to exaggerate his/her compliance.

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The Relevance of User Evaluation Research for e-Health-Applications in the Homecare Setting

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Abstract - BACKGROUND: Within the broad field of e-health specific attention is being paid to telehomecare applications. In this domain more attention has to be paid on the intertwining of technological design and the contexts of use. In order to optimise an effective and efficient implementation of telehomecare technology the user perspective needs particular attention. Lessons can especially be learned from 'the social construction of technology' literature focusing on the 'technology as an artefact' and 'the social context' in which the technology is embedded and from evaluation research.
OBJECTIVE: We will demonstrate the importance of User Needs assessment. Knowledge and insight has to be gained in the particularities of the healthcare sector as a critical part of the design and implementation of telehealth applications.
METHODS: Experiences in pilot telehomecare projects in Belgium, demonstrate the added value of user evaluation research. Using a constructive technology assessment (CTA) approach the follow-up, development and introduction of the telehomecare applications in the primary healthcare field is being done. The perspectives of the different stakeholders, with their own needs, expectations and values, are studied, evaluated and integrated in an evaluation framework, and taken into account when designing and implementing the technology.

I. INTRODUCTION

Information- and Communication Technology (ICT) is becoming more and more important in the healthcare sector. While many technologies have already found their way in the intramural setting, more and more attention is being paid to telehomecare applications. In this domain more attention has to be paid on the intertwining of technological design and the contexts of use. In order to optimize an effective and efficient implementation of telehomecare technology the user perspective needs particular attention. In particular, lessons can be learned from 'the social construction of technology' literature focusing on the interaction between 'technology as an artefact' and 'the social context' in which the technology is embedded. Evaluation research offers some additional insights on methods.

A. The social construction of technology

Recent developments in science and technology studies, in information systems research and organization studies urge not to use a technological deterministic paradigm. Technological determinism holds the idea of an unidirectional impact of technology on society ('black box'). In a response to this instrumental vision the social construction of technology demonstrates that users are not passive consumers of technology. Pinch and Bijker identify 'relevant social groups' who give meaning to the technology and thereby co-design (in collaboration with the manufacturers) the artefact [1]. Technology and its social environment are mutually interdependent [2]. Technologies are both mediating social roles, and are shaped within the context of particular roles [3]. As technology is embedded in society, values, norms, power relations and other social constraints influence the shaping of technology. On the other hand the use of new artefacts can in turn alter the existing values, norms and work routines. In other words, technology can be cause as well as effect: technology can be shaped by society, and will shape society [2].

Especially in healthcare, too little attention is currently paid to the (potential) consequences of an ICT application on work practices and roles of different potential users. Explicit debates and reflection on the impact of technologies on future roles, can help to clarify the development and use of technologies. One of the particular research issues for the future of e-health, is studying the implicit 'scripts' in technologies assigning tasks and duties to different persons, or interfering with institutionalized interaction patterns [4]. In order to avoid that ICT applications will affect the persons and roles in undesirable ways, a specific methodological approach can be used: constructive technology assessment.

B. Evaluation research

Healthcare evaluation research of technologies mainly uses quantitative methods [5,6,7,8]. This tradition is clearly

demonstrated by a review of Ammenwerth and Keizer [8], who made an inventory of evaluation studies of information technology in healthcare between 1982 and 2002. The majority of these studies can be classified as summative evaluation research. Summative evaluation, often randomized controlled trials, scrutinize the outcome or impact of an intervention, in this case the technology [5,9]. Hence, this kind of technology assessment takes place after implementation of the application [5]. Most of these summative evaluation studies provide outcome evidence confirming the clinical and cost-effective benefits of e-health-applications. Some of these studies also refer to the high degree of patient satisfaction [6,7].

Currently, qualitative research is slowly penetrating the evaluation of e-health applications [5,7]. A large amount of these studies can be identified as formative evaluation studies. Its scope is not restricted to outcome measurements, but include an assessment of the planning, development, introduction, implementation and operation of ICT-technologies in healthcare [7,8]. The need for more process-oriented evaluation approaches is being stressed [5,7,10], in order to explain the failures of normalization (daily routine use) [7]. Failures are considered to be a result of the lack of insight in the human factors and processes associated with the development, implementation and use of technology [5]. Moreover, formative evaluation generates feedback for modification of the technology before its market introduction [5,9]. In process evaluation these adjustments are retested and evaluated, thereby regenerating feedback for further refinement of the technology, and this in an iterative way.

II. OBJECTIVE

This paper demonstrates the importance of User Needs assessment. Knowledge and insight has to be gained in the particularities of the healthcare sector as a critical part of the design and implementation of telehealth applications.

This paper discusses the experiences from a telehomecare pilot study. This project designed and introduced a telemonitoring application, measuring blood pressure and glycaemia, in the homecare setting of patients of the homecare organization. This homecare organization is covering the whole Flemish region and parts of Brussels. The overal organization is structured around quite autonomous provincial departments (with their proper management structure). Within the provincial levels care provision is organized in small scale local units. The homecare nurses are assigned to the local units and visit the patients in their home. Given the fact that blood pressure and glycaemia measurement by the homecare nurse is not financially compensated (nor by the patient nor by the social security system), this act is expensive for the homecare organization. From a management point of view, this telemonitoring application was developed in order to improve the efficient allocation (of time) of nurses.

III. METHODOLOGY

The relevance of user evaluation research will be illustrated by findings from a pilot telemonitoring application. The telemonitoring system is composed of three elements: (1) the measuring device (sphygmomanometer or glucometer), (2) the data transmission between the measuring device and the central server, registering the results – the communication occurs trough an analogue telephone line, (3) the central server and the accompanying software to analyse and report the registered data. The application is introduced stepwise in different local units of the participating homecare organization.

Insights from 'the social construction of technology' [1] and process-oriented evaluation research advocates for a methodology for constructive assessment, a specific form of formative assessment[1] [11]. By including the potential users, CTA intends to steer the development and diffusion process of technology [12]. In contrast to a traditional approach offering users only afterwards an opportunity to express them on usability and acceptability of the application [13], CTA includes proactively the perspectives of the users, user contexts and societal aspects in the design [14]. Hence, the device does not only need to respond to predefined technological criteria, but should equally take the (organizational) environment in account [9,11].

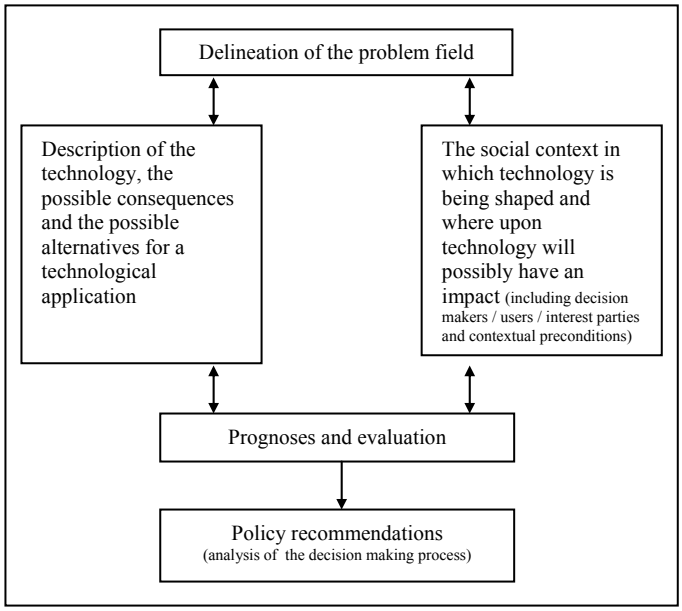

Figure 1 The basic components of a CTA approach [15]

Fig. 1 illustrates the basic structure of the used CTA-methodology. The reciprocal arrows indicate that the development of new technologies is a dynamic process.

Our evaluation model starts with collecting information regarding the social context in which the new technology will be implemented. This information is translated in criteria, developed for refinement of the design rules. During the implementation phase the predefined criteria can form the

[1] Assessment encloses the concepts of evaluation (measuring), verification (checking off characteristics against checklist) and validation (assessing against the stated objective) and valuing (giving priorities).

basis for assessing the impact of technology on the social context. This evaluation can in turn alter the design of the technology and the management and support systems for implanting a technology in the healthcare field.

In the pilot studies a CTA approach was used during the design, development, introduction and follow-up of the telehomecare applications. The perspectives of the different stakeholders, with their own needs, expectations and values, are studied, evaluated and integrated in an evaluation framework, and taken into account when designing and implementing the technology. During the implementation phase of the telemonitoring application the perceived expected impact of the technology on the different users is systematically assessed, applying an inductive qualitative method. In-depth interviews are conducted with the different user groups (patients, homecare nurses, head nurses and general practitioners). The usefulness of the technology for patients and healthcare professionals is questioned. Information regarding the experiences using the application and eventual barriers in use is collected. During data collection and analysis the social context, living and working environment, and the individualities of the involved actors is being considered. Consequently, an in-depth insight can be gained in the way users give meaning to the technology, the so-called interpretative flexibility [1]. Based on this analysis an input is given for fine-tuning the design rules of the technological application.

IV. RESULTS

Based on the transcripts of our in-depth-interviews these findings are described according to following analytical categories: 'technology-intrinsic characteristics', 'user-centered characteristics', 'interactional aspects' and 'institutional field healthcare'. We start with a global overview of the participants.

A. Description of the participants

Three local units of the homecare organization participated. The telemonitoring application was installed in the homes of 25 patients: in the first local unit blood pressure telemonitoring was performed by 11 patients; in the second local unit 5 patients were selected for blood pressure monitoring; in the third local unit 3 patients and 6 patients were monitored for blood pressure and glycaemia, respectively. These patients belong to an older age group (60+), which is not surprising knowing that most of the patients of the participating homecare organization belong to this age group.

In total 14 general practitioners were involved in the pilot study (4 linked to the first local unit; 3 to the second local unit; 7 to the third local unit). In each local unit the head nurse was questioned regarding his/her experiences with the telemonitoring application. A total of 13 homecare nurses were interviewed with respect to there opinions concerning the technology (6 nurses from the first local unit; 3 from the second local unit; 4 from the third local unit).

B. Technology-intrinsic characteristics

'Ease of use' has been shown to be positively correlated with a high level of acceptance by the user. A well designed technology should in itself instruct the consumer how to handle the device [16]. According to system-centered theories resistance can be explained by features inherent in the technological system itself, also called technological barriers [6].

Although the manufacturer of the telemonitoring application tried to make the technology user friendly, still the participants made some comments with respect to the user friendliness of the telemonitoring system. Many examples come to the fore but we restrict ourselves to the most striking example. In the first unit, where the telemonitoring application was implemented, a sphygmomanometer without a power button was used. One of the patients complained that the device was always 'active'. Hence, a new blood pressure meter was equipped with a power button was used in the following units. This slightly increased complexity of the artefact resulted in a wrong use of the technology. The sphygmomanometer was switched off before the datatransmission took place, thereby no blood pressure result was registered.

C. User-intrinsic characteristics

'User-centered theories' attribute the resistance in use of IT to personal user-characteristics [6]. General behavioral theories have demonstrated that behavior is defined by knowledge (cognition), attitudes (values, norms, expectations), intentions and stress-factors. All these individual behavioral characteristics are reinforced by interactional and contextual elements [17,18].

Knowledge is one of the user-intrinsic characteristics explaining resistance [6]. Before the implementation of the telemonitoring application most patients gained knowledge about their medical conditions via healthcare professionals. During the implementation phase of the telemonitoring application, development of the knowledge of the disease is mediated through a device.. By measuring their own blood pressure and/or glycaemia and seeing the results, this knowledge abut their condition is increased. A better sense of control on the management of their condition is reached. It is to say, this effect is anticipated by physicians.

Conversely, the accomplishment of the desired effect of improved awareness of the health status can be hindered by an insufficient technological knowledge. Many of the participating patients did not have any experience with this kind of rather 'hard' technologies, and uttered many concerns. Technology is substituting personal contacts with nurses or general practitioners. Moreover, older people fear technology as such, often because of a lack knowledge and experience with technological devices. Resistance of future use of the telemonitoring system as a consequence is not surprising. Especially elderly bring the argument of non-experience into play.

Even if technical knowledge does not thwart the possibility to enlarge their medical understanding, this latter can be hampered by unintended impacts related to the use of

technology. One of these effects are enhanced feelings of anxiety.

D. Interactional aspects

'Interactional theories' try to explain emerging resistance due to interrelationships and interactions, between technology users and social context in which the system is used. New evaluation approaches take the impact of a technology on the organizational and interrelations between users into account, but similarly appraise the reverse impact of the social environment on the technological system [6].

C.1. Professional and patient level

Next to patients, different healthcare providers are operating in the homecare field. The different stakeholders often have a dissimilar view on the use of technology, in this case the telemonitoring application [9]. In some cases this can trigger contradictory attitudes.

Physicians gained professional dominance and the monopoly over certain (medical) activities due to historical and sociological developments. It results in physicians expected roles of nurses and vice versa, and power relationships between different healthcare professionals [7]. Understanding and considering these professional roles and perceived responsibilities can enlighten the use and attitudes concerning technology and the delegation of tasks towards other professional groups in the healthcare domain [19]. The appraisal of a technological system is, against this background, affected by professional values. The protection of and strive for autonomy is one of the most important examples [6].

Technology can evoke reservations about professional roles The telemonitoring application induced the questioning of the role of the homecare nurse with respect to the implementation of this technological system. Negotiations about the roles and delegation of tasks between healthcare providers can induce tensions [7]. These tensions often stem from a perceived danger for loss of power and authority, certainly when these professional groups are the owners of 'cultural capital' [20]. General practitioners claim for a greater participation in the project and request participation in patient selection. The participated general practitioners appeal to be directly informed of biometric alarms. Partly these visions can be explained by their professional culture. The telemonitoring system can undermine their professional status as diagnostician and gatekeeper in the primary healthcare sector. Physicians have strived and gained the 'diagnostic and therapeutic freedom', and are not willing to loose this 'power'.

Despite a shift in tasks, medical innovations, including technologies, may strengthen hierarchical relations [20]. The delegation of routine tasks to paraprofessionals , in this case homecare nurses, by means of a technological device reinforces the professional dominance of one professional group over the other [21].

Another aspect of shifting roles through the implementation of a technology, is the role of the informal carers. Technology in the primary healthcare field may blur the boundaries between formal and informal caregivers [7,16]. In settings in which technologies require more self-care, informal caregivers are becoming ore important. In our research the use of the telemonitoring application resulted in the take over of blood pressure of glycaemia measurement from homecare nurses to patients or informal caregivers. This shift in tasks does however not always occur without protest. For example one of the informal caregivers considered blood pressure measurement being a nursing task. Accordingly, she refused to monitor the vital parameter when the homecare nurse visited the patient (for other nursing care tasks).

The success of e-health applications for healthcare providers is dependent on a good fit between the technical system and the clinical workflow [9]. A mis-match between the datatransfer (a component of the technological system) and the clinical routines of general practitioners could be observed. The data were transferred to the physician on a weekly basis. Some of the general practitioners claimed this frequency to be too high, thereby adding to the already existing 'information overload'. The data are needed on the moment physicians have contact with the patient in question. Receiving the data in between these contacts has no clinical value and is considered ballast.

C.2. Organizational level

The social or use context of a technology should be reflected in the design of the technological system [16]. From an organizational or work-processes perspective, the actual work routines are to be taken into account when defining the design rules of the artefact [6,9]. It already has been demonstrated that the embedding of technological innovation in the current work routines of an existing organization often is one of the bottlenecks, especially when the tend to change institutionalized interaction patterns [7,22]. This is important to keep in mind when developing "pilot-projects". The parallel implementation of "experimental" systems can mostly be achieved without great problems, when they are not affecting fundamental work practices and interaction patterns. However, the integration of 'real' e-health-services is less evident. The disturbance and destabilization of institutional and professional dynamics of the existing organizational structures are recognized as one of the causes of these failures [7].

The same technology can lead to differences in use and attitudes [9]. The same IT system can develop as a success in one setting, but as a failure in another setting [23]. In our study different visions in the different local units about certain aspects of the telemonitoring application emerged. One of the possible explanation for these observed differences can be dissimilarities in user-characteristics, organizational culture and workflow. Additionally, we should not neglect that the attitudes of users towards technology are influenced by their reciprocal communication. Subsequently, this has an impact on how and by whom the technological system is used, and equally their attitudes [6]. Thus, this may have added to the dissimilar views of the homecare nurses in the different local units.

The introduction and implementation of a technology has to be accompanied by specific measures. This programme of change is required to have a successful implementation of the technology. Training, support and motivation of the different stakeholders are essential parts of the introduction [9,22]. influence the willingness of actors to participate and change behavior. E.g. despite the fact that the interviewed nurses as well as the head nurses considered the training as sufficiently detailed, support during the implementation of the telemonitoring application was not very well maintained. The period between training and implementation was sometimes long, and in the period that the application was operational, the head nurses seldom had contact with the project coordinator. Neither were they fully aware of their expected role and tasks when the technology was implemented in the patients home. The nurses did not receive more information than the one offered during training, resulting in a loss of commitment of the different stakeholders (including general practitioners) towards the "pilot" project. Several statements of patients let us assume that they rated this commitment as low.

The ability of an organization to handle flaws is important [22]. Support and adequate information can help to enhance this ability. In this organization the capability of the homecare nurses, who had most direct contact with the patients, to deal with errors was rather low.

E. Institutional field healthcare

The healthcare field is extremely complicated and can not be compared to the traditional consumer market. Besides private values, public demands are equally important and need to be considered for the development of e-health-applications. Specific legislation, policy options, cultural aspects and economic constraints equally influence the acceptance and use of telemedicine applications.

In healthcare, consumer behavior is to a large degree triggered by the package of reimbursed care. In the telemonitoring project this effect is illustrated by the stated resistance about future use of the telemonitoring application by diabetes patients because of non-reimbursement. Furthermore, the low percentage of patient recruitment for glycaemic telemonitoring can be ascribed to a specific Belgian regulation for diabetes patients called the "diabetes convention". This convention is an agreement between the national public health insurance (R.I.Z.I.V.: Rijksinstituut voor Ziekte- en Invaliditeitsverzekering) and different Belgian hospital based diabetes centers. These centers offer diabetes patients education and material for blood glucose monitoring under strict conditions. Because of this regulation a lot of diabetes patients who are legible for the diabetes convention, will not fall into the homecare regulation. In the second pilot study the existence of this convention has equally narrowed the range of the selection sample.

The attitudes of general practitioners are closely linked to financial concerns. The 'fee for service' system in Belgium hampers a positive attitude of general practitioners, because the technology is potentially affecting revenues. Fear of a decrease in the amount of consultations is expressed. Subsequently, concern regarding their income is uttered.

Furthermore, questions about the legal and medical responsibility over their patients raises particular concerns. Physicians are very concerned with legal accountability and request control over their medical domain without interference of others. For example, several general practitioners state that interpretation of the registered data is a solely physical task. It is medically irresponsible to give homecare nurses the authority to interpret the measured blood pressure or glycaemia results, given the fact that they do not possess the necessary medical knowledge.

V. Discussion and Conclusion

Our user-centered evaluation research has some particular methodological limits. The external validity of the results of our study can be questioned, because we focused on a "voluntary" public. Restricting the recruitment to the users who agree to participate (informed consent as a conditio sine qua non), risks that certain aspects related to user-centered barriers will remain obsolete. Moreover, the participants are more motivated compared to 'normal' users, resulting in the volunteer effect [9]. Hence, this compromises the external validity of the study. Ammenwerth and co-workers [9] identify uncertainty of generalization of the results of small pilot studies to other environments as one of the problems related to IT (information technology) evaluation studies. Thus, external validation is not always easily achieved. In the telemonitoring project, this problem is slightly intercepted by the enclosure of different units, though of one homecare organization.

On the other hand, our results fit very well in results of other user-oriented research in the e-health sector. It leads to a conclusion on the importance of process-oriented studies which can elucidate how and why many e-health-systems fail to survive in the long term.

E-health applications designed and developed, using the input of qualitative user evaluation research, will closely connect to the real user needs. Consequently, these applications have a higher likelihood for successful integration and acceptation in the healthcare field [5]. Indeed, our results confirm Ammenwerth's [9,23] recognition of the dependence of the success of e-health applications on the fit between technology and workflow, a good introduction in the organization accompanied by training and support, on the depth of use, as well as on the enthusiasm of the users.

VI. Recommendations

We wish to give some 'general' recommendations for further development of e-health applications in the homecare setting.

- The technological system and the social context in which the system will be implemented, should be described in detail [9]. Identify all involved actors and unravel their social background. Disentangle habits and work routines of professionals.

- Make a description encompassing the introduction and use process of the e-health system [9]:
  - We recommend a translation of this description in a protocol, where the different user roles and associated tasks are well-defined.
  - The participation of all potential users, or at least their representatives, in the production of this protocol is advocated. Based on the FIT framework, the fit between the user (the individual), their tasks and the technology can be achieved by involvement of the user in the selection process [23];
  - A clear implementation plan should be made: identify the different steps to be taken, by who and eventually when.
  - The protocol should include a clarification of the hierarchical steps to be taken with the occurrence of potential hazards.
- The responsible management, including the staff in charge of patient selection and recruitment, should be well informed and motivated. Making participants aware of the fact that involvement in the project is their chance to influence future development of e-health applications can be a triggering argument [9].
- All changes that occur during the evaluation phase should be well documented. Again, this does not only account for technical modifications, but includes environmental alterations (users, workflow, staff, …) [9].
- More attention should also be paid to user feedback, which can act as a driving force for participation [9]. It is not sufficient to just install the application in the homes of patients, without further follow-up. Give users continuous support:
  - Educate users in using the technology.
  - Foresee a clear manual.
  - Do not forget a helpdesk, which users can always reach in case of problems.

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NFC – the Intuitive Link between People and eHealth

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Abstract - Mobile information and communication technologies are increasing rapidly. Thus, the mobile phone is particularly qualified as patient terminal for supporting patients suffering from chronic diseases in their self-management process. It provides mobile and fast interaction between patients and their caregivers. In such concepts, the most challenging part is still the human computer interface, i.e. to support the user to interact with the system. The object of this paper is to demonstrate a new kind of patient terminal based on mobile phone technology that provides an intuitive and easy-to-use way to acquire and transmit health related data using NFC technology. Based on this upcoming wireless communication technology a prototype was developed to transmit the measured values from a blood pressure meter to a monitoring centre just by touching the device with a special NFC – enabled mobile phone.

I. INTRODUCTION

Patients suffering from chronic diseases are asked to track their key measures like blood pressure, pulse, diabetes relevant data or events by daily writing them down into lists, tables and diaries. The captured data are expected to show trends in the illness patterns and to help the doctor in guiding the patient to the best possible health status. However, patients´ compliance using the conventional method of self-management is often poor and the interpretation of the hand written data is difficult, error prone and time consuming [1].

The availability of mobile information and communication technologies is increasing rapidly and provides huge opportunities for home monitoring applications. The high availability and the benefit of absolute mobility of mobile phones makes these devices particularly interesting for the usage as home monitoring terminal to provide an active interaction between patients and caregivers. According to this concept the patient enters his/her self measurements into the mobile phone and sends the data over the mobile phone network to a monitoring centre (Figure 1).

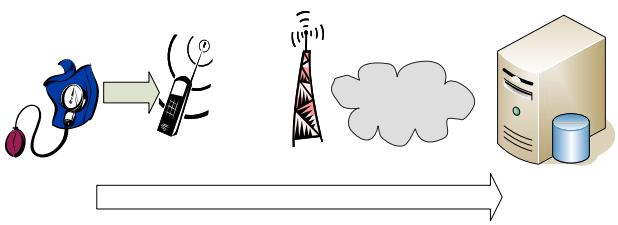

Figure 1: Dataflow of blood pressure values from the patient to the monitoring centre

The monitoring centre hosts a central database where received data are stored, managed and processed. An automated monitoring process checks the values and gives feedback in order to guide the patient through the self managing process and to turn the doctor's or other caregiver's attention to the patient when necessary by means of notifications and alerts. However, in such concepts, the most challenging part is still the human computer interface, i.e. the way data are entered into the system. A major focus of our research activities has been to develop and test new ways to utilise mobile phones for home based health data acquisition. A common way to transmit e.g. the blood pressure to the monitoring centre is to transcript the values, read from the meters´ display, by typing them via keypad into the mobile phone. A number of clinical trials have already been accomplished using Wireless Application (WAP) technology or mobile phone based Internet browsers to provide the user with an adequate communication interface [2].

Novel mobile phones support a Java based virtual machine Java 2 Platform Micro Edition (J2ME) which allows running stand-alone software applications. The software can be designed using core application functionality - including graphical user interfaces, network connectivity and local data storage. Basically, the software guides the patient through the data acquisition process, stores the data locally and synchronizes them afterwards on demand.

In both cases, however, the user has to interact with the small keypad and display of the mobile phone. To provide the user with an easy-to-use method to acquire and transmit data automated or semiautomatic, mobile phone based methods have been developed, for example based on Bluetooth [3].

However, up to now, there is no method available which fulfils all criteria of an ideal patient terminal in terms of usability, adaptability, flexibility, and last but not least in terms of costs. The now available NFC - technology has the potential to improve the situation with respect to those critical features.

Near Field Communication (NFC) is a short-range communication concept based on Radio Frequency Identification (RFID) technologies. The components of a typical RFID system are the reader/writer unit and one or more passive transponders. A passive transponder is an electronic data storage medium without power supply that can be read out or programmed contactless within a certain distance from the reader. There are already several application areas in the health care domain, where RFID technology is used – mainly as an alternative to the barcode for identification issues. Classical RFID technology is asymmetric in the sense that there are different roles for the reader and the transponder unit.

NFC as the subsequent development of this technology breaks this separation and allows bidirectional communication between two equal NFC enabled devices at a data rate of up to 424kBit/s. Furthermore NFC is compatible to the existing RFID transponders and contactless smart card infrastructure [4].

The basic idea of NFC is to enable data exchange between two devices within a range of centimetres in an intuitive, easy to handle, and secure way. Just by bringing two devices close together or even make them touch the communication starts automatically without the need of any further interaction or initial configuration, which makes this technology indeed interesting for home monitoring applications.

The NFC communication module is a single chip solution that will soon be integrated in several mobile devices, like mobile phones, personal digital assistants (PDA) or laptops. Thus the user will be able to access and exchange data just by touching NFC enabled devices or passive transponders without the need of any user interaction or cumbersome configuration procedures.

II. METHODS

The Nokia 3220 has been one of the first available mobile phones which could be extended to support NFC functionality. An special NFC shell (which can be acquired separately) contains the NFC communication module and the coil-like antenna. Additionally, this mobile phone provides the basic software environment to read and write data (e.g. a telephone number) from RFID tags. For example, by touching such configured tags the mobile phone runs the predefined service like making a phone call, sending a predefined short message (SMS) or opening a web page in the integrated web browser [5].

The possibility to access mobile web services just by touching a tag has been the initial motivation to create a patient terminal based on NFC technology.

The basic idea is to fetch the measured data from a medical device (e.g. blood pressure meter) just by bringing the NFC enabled mobile phone close to it - followed by an automatic transmission of the data to the central monitoring centre via the mobile communication network. Data acquisition and transmission can be facilitated without the need of any user interaction.

To explore the feasibility of the NFC technology in the eHealth domain an all-purpose NFC module has been developed which can easily be integrated into various medical measurement devices.

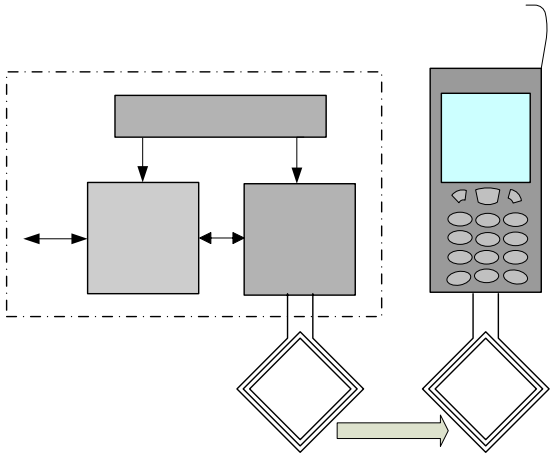

Figure 3: schematic configuration to acquire various data by touching a special module with the NFC enabled mobile phone

Figure 3 shows the schematic configuration consisting of the key elements, i.e. the developed module (encircled by the dotted line) and the NFC enabled mobile phone that provides the intuitive procedure to fetch and transmit various types of data.

The developed NFC module features an embedded microcontroller to receive data from the medical device. For this purpose the microcontroller supports a set of various I/Os to establish an interface to other controllers or memory units. Additionally, signals from any type of sensors could be received via the analogue input port.

After pre-processing a timestamp and a unique device ID is appended to the data. The second task of the microcontroller is to communicate with the NFC chip via command answer protocol. As a consequence, one of the possible communication modes is selected to communicate with the mobile phone.

The antenna is attached on a separate printed circuit board to be placed apart from the module. Since the data can be read out only in the vicinity of the antenna, the location has to be chosen appropriately, e.g. beyond the cover or even around the display.

After the measurement, the data to be transmitted are available in the microcontroller's memory. Hence, the user can touch the medical measurement device with the NFC enabled mobile phone – at the point where the antenna is located. Once the distance is close enough a the software running on the NFC enabled mobile phone starts

automatically, receives the data from the integrated module and initiates data transmission to the central database over the mobile communication network.

III. RESULTS

In the course of a research project a NFC enabled module has been designed and integrated into an of-the-shelf blood pressure meter (BOSO medicus pc, BOSCH + SOHN GMBH U. CO. KG, Jungingen, Germany). The developed module is implemented in surface mounted device (SMD) design and, therefore, requires just small dimensions of 30x35mm.

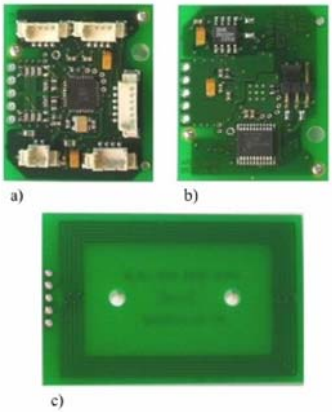

Figure 4: developed NFC module in (a) top and (b) bottom view and (c) the antenna separately implemented

Figure 4 shows the circuit board of the developed NFC communication module. The NFC chip and its necessary adjustment circuit to actuate the antenna are placed on the top side (a) surrounded by SMD plugs. By means of these plugs the signal lines of the medical device can be connected to various I/O pins of the microcontroller placed on the bottom side (b). Furthermore a voltage controller is mounted on the bottom side that supports the components with the required constant voltage level. To flash the program controlling the microcontroller it offers an "in circuit serial programming" (ICSP) port that allows uploading the code to the controller embedded in circuit. The antenna (c), a coil with six turns, can be placed at a separate location.

The developed demonstrator - consisting of a blood pressure meter and the NFC enabled mobile phone - is shown in figure 5.

Figure 5: working prototype consisting of a blood pressure meter and NFC enabled mobile phone

As indicated in the picture the antenna is located behind the cover right besides the display. This position makes the information accessible at the place where it is shown visually.

The integrated NFC enabled module monitors the blood pressure meter and in case of a new measurement the data (diastolic blood pressure, systolic blood pressure, and heart rate) are read out from the device's memory. These data are extended with the actual timestamp, a unique device identifier and a checksum. Thereafter the microcontroller operates the NFC communication module which provides the data via the contactless interface to be read out by the NFC enabled phone.

By touching the meter with the phone at the right place the installed application starts automatically and displays the question if a "general packet radio system" (GPRS) connection should be opened. After confirming by only one key press the data are transmitted via the mobile phone based browser. Finally, an acknowledgement indicates successful transmission and displays the data as received be the monitoring centre [6].

In the course of a feasibility study a demo site has been implemented. This web page provides access to the data transmitted from the various NFC enabled blood pressure meters. The user enters login data containing the device ID and the corresponding password to view the data he/she has sent before. The values are shown in plain text or if required in a box plot diagram [7].

IV. DISCUSSION

Many of the components necessary for home-based health monitoring application are readily available or can be designed and developed based on standard state-of-the-art Internet technology. The most challenging part is the patient terminal, i.e. to provide the user with a method to enter the measured data into the system. Ideally, this human computer interface would have the following properties [8]:

(1) **High usability.** Elderly, technically unskilled persons should also be able to use the device in an intuitive and efficient way.

(2) **Error-resistance.** Human computer interaction should leave no room for data acquisition errors.

(3) **Offline data acquisition**. It is a well known fact that wireless networks lack 100% availability (e.g. in buildings). To provide the user with the possibility to enter data at any time and any location, intermediate local data storage is desirable.

(4) **High flexibility and adaptability.** Patient terminals should provide flexibility in terms of adding or removing parameters corresponding to changing conditions in the treatment.

(5) **High security level.** In general, handling health related data requires a high level of security.

(6) **Bidirectional communication.** The ideal patient terminal combines the possibility to provide the user with an interface not only for entering data but also for receiving

feedback (e.g. reminders or medical advice on the same device).

All of these features could potentially be covered by the now available NFC-technology combined with NFC enabled mobile phones used as patient terminal in home monitoring applications.

TABLE I
COMPARISON OF NFC TECHNOLOGY FOR MANULALLY OR SEMIAUTOMATICALLY METHOS FOR DATA ACQUISITION
("+" … THE METHOD COMPLIES WITH THE REQUIREMENT
"-/+" … COMPLIES ONLY PARTLY
"-" … DOES NOT COMPLY)

	Data Acquisition		
Requirement	manual	Semiautomatic	NFC-based
overall usability	-	-/+	+
error resistance	-	-/+	+
offline data acquisition	-/+	-/+	-/+
high flexibility & adaptability level	-/+	-	+
high security level	+	-/+	+
bidirectional communication	-/+	-/+	+

In the course of a feasibility study with a goup of users consisting of 18 students the developed prototype has been compared to previously developed mobile phone based patient terminals.

Table 1 gives an overview of the requirements and the degree of compliance of the manual, semiautomatic and NFC based methods.

Manual methods e.g. using the WAP browser or a software application require a transcription of the values shown on the display and an interaction with the small keypad resulting in low usability. Furthermore, transcription errors, missing values or incomplete data is no un-common.

On the other hand semiautomatic methods like transmitting the values via Bluetooth to the mobile phone require some keystrokes anyway to send the data to the monitoring centre. Moreover, cumbersome setup procedures (searching and pairing of the Bluetooth devices) renders this technology difficult to use for technically unskilled people.

Furthermore, Bluetooth just allows communicating with active devices. On the other hand, NFC is also able to communicate with passive tags which can be used to acquire other kinds of information.

Another advantage is that NFC, although easy-to-handle, still keeps the user in control of this process. For basic use a special application is not necessary but the already existing application pre-installed on the mobile phone can be used. This means that the blood pressure meter can be read out with every NFC enabled mobile phone without any further installation or configuration ("out of the box").

The NFC based method provides an intuitive, automated and error prone way to capture health related data. Furthermore, there is no need for cumbersome user interaction, meaning the system can be applied without extensive deployment. The adaptability and flexibility of this method is notably high, because the developed NFC module can be integrated in lots of medical devices in a home monitoring environment. Additionally, the mobile phone provides bidirectional communication - allowing the patient to transmit as well as to receive information from the monitoring service centre.

Offline data acquisition is possible in principle but requires an adaptation of the software running on the mobile phone, which handles local data storage and synchronisation afterwards.

At the moment NFC enabled phones are slightly more expensive but in the future various mobile phones will be equipped with this NFC interface which will make NFC technology ubiquitously available at low costs.

CONCLUSION

In summary, NFC technology has the potential to act as the intuitive link between people and eHealth concepts. Particularly elderly and technical unskilled people may benefit from NFC technology allowing them to capture their health related data in home monitoring scenarios.

ACKNOWLEDGMENT

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Information Center for Persons with Disabilities

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Abstract-The paper presents some results of the Romanian Web-based application "Development of information services for persons with disabilities (PwD)" – InHand. The main goal of the application is to contribute to improve the quality of life and health status of this group of people. Our emphasis throughout the paper is on the benefits of universal design. By eliminating barriers that prevent people with disabilities from using your Web site, you actually make your site more useful for all your visitors.

I. INTRODUCTION

The "i2010 – A European Information Society for growth and employment" initiative presents a new strategic framework and broad policy orientations to promote an open and competitive digital economy, emphasizing Information and Communication Technologies (ICT) as a driver of inclusion and quality of life. To achieve an "Information Society that is inclusive provides high quality public services and promotes quality of life" is one of the core objectives set out in the i2010 framework [1]. Accessible ICT will improve the quality of life of people with disabilities significantly. At the same time, the lack of equal opportunities to access ICT can lead to exclusion.

The Information Society is an objective of the development and not a desideratum in itself; it is an essential component of the politic and economic programme for development and a major condition for integration of Romania in the Euro-Atlantic structures. In the National Strategy for the New Economy and the Implementation of the Information Society [2] developed by the Romanian Ministry of Communications and Information Technology there are several actions in order to enable access for all to Information Society specific services:

- Special measures to adopt the standards for accessibility of information technology products ("Design for all"), in particular to improve the employability and social inclusion of people with special needs;
- Review relevant legislation and standards to ensure conformity with the principle of accessibility;
- Adoption of the Web Accessibility Initiative (WAI) guidelines for public websites;
- Ensure the establishment and network connection of national "Design-for-all" centers of excellence.

Increasing, Romanian research activities are contributing to the improvement of the citizens' quality of life in a global Information Society. One of the fields of the recent „Excellence research project", launched by the Romanian Ministry of Education and Research, is ICT meeting societal challenges aiming: to improve equal participation in the information society, to prevent digital divides, to promote assistive technology and design-for-all principles.

The Romanian National Authority for Persons with Handicap (ANPH) was created as a specialised body of the central public administration and legal authority, subordinated to the Ministry of Labor, Social Protection and Family. ANPH coordinates, at national level, the activities for the protection and promotion of the rights of the persons with handicap. It is its responsibility to develop policies, strategies and standards and to ensure the follow-up of the application of national and international regulations in the field and to monitor and supervise all protection and promotion activities related to persons with special needs.

The article 77 of the "Law concerning the protection and the promotion of the rights of the persons with handicap" [3] developed by ANPH and adopted by the Romanian Government requires that until December 31, 2007 public administrations act in order to provide the access of the persons with visual and mental disabilities to public web sites and to improve their access to electronic documents.

The Web offers to people with disabilities so many new opportunities that are unavailable through any other media. It provides an easy way for accessing information, making purchases, communicating with the world, and accessing entertainment that does not depend on the responsiveness of other people. The Internet offers independence and freedom[4]. But that can become a reality for persons with disabilities and they can benefit of the full potential of the web only if the accessibility is ensured.

Stephanidis & Emiliani in [5] are defining the accessibility as the global requirement for access to information, communication and social interaction by individuals with different abilities, requirements and preferences, in a variety

of contexts of use. Traditionally, accessibility has been associated with disabled and elderly people [6] and reflects the efforts devoted to the task of meeting prescribed code requirements for use by PwD.

It is well known that nothing else but data exchange and shared experience may determine successful concerted actions. That is why the idea of a web site making the domain information largely available to those directly interested and to those who are in charge of the domain was born, and here is the InHand project. We call it "InHand" in the hoped that we will be able to handle this problem, even with low financial support. Our expectations are that in time we will have the necessary support to develop Web-based applications on behalf of almost all categories of disabled people.

The aims of the InHand project are:

- to offer to the persons with disabilities access to a wide range of information and societal resources and a means by which they enter into social contact;
- to develop new Web-based applications for people with disabilities and older people, to enable them to participate more fully in social and economic life;
- to eliminate barriers to employment for workers who are disabled;
- to disseminate the "Design for all" standards for accessibility of information technology products.

II. Materials and Methods

The InHand databases that are accessible via the Internet have been designed to back up the information delivery to persons with disabilities who ask for assistance. The databases store data about persons with disabilities who ask for assistance as well as data about organisations having the wish and the possibility to provide assistance for disabled or elderly people. So, given the access to the databases via the Internet, the two categories (data users and data suppliers) get easily in touch with one another.

The InHand application was developed using HTML, XML and ASP (Active Server Pages) technologies. InHand database was developed using Microsoft SQL Server 2000.

In many cases we have to choose between executing the script code on client, by browser interpretation, or on the web server, using ASP. We used especially server scripts with ASP technology in InHand application, so the source code of the script is executed on server and the user can see only the HTML code that is accessible.

The current site complies with the Web Content Accessibility Guidelines 1.0, priority 2. We focused on accessibility but we adopted also a usability perspective, the real goal being to help the users with disabilities to better use the InHand application.

We have developed two databases that contain:

- data about persons with disabilities (PwD-Electronic Record) and;
- data about organisations (potential assistance providers), projects related to disability, laws and regulations, jobs and services offered to PwDs.

To collect the data about Persons with Disabilities a form known as: "Electronic Record" is distributed. The objectives pursued are the following: active identification of the cases in which assistance is mostly needed, monitoring of the categories of beneficiaries, drafting of regulations pursuant to collected data analysis, offering new types of assistance. The PwD Electronic Record contains the following types of information:

- general data about PwD (Figure 1);
- living conditions;
- data concerning the health and the care (physical aspects, nursing (Figure 2) , sociability etc.).

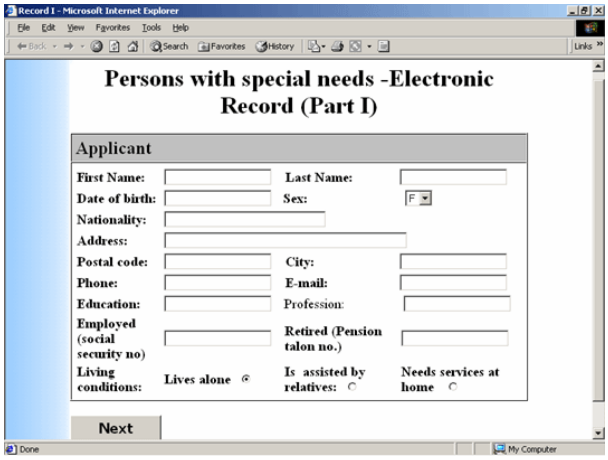

Figure 1. Electronic record. Part I

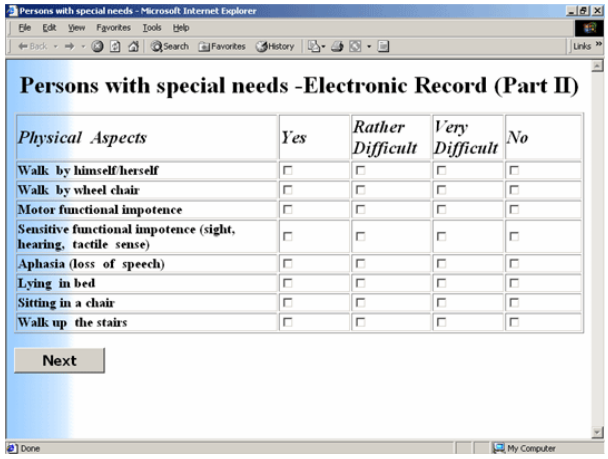

Figure 2. Electronic record. Part II

Records and information can be collected and incorporated continuously via Internet without extensive human resource requirements for re-entering information. Users have access instantly to up-to-date information.

III. Results

A site presenting the InHand project has been launched and this aligns to the W3C Recommendation - Web Content Accessibility Guidelines. Focused is:

- to make our Web pages accessible to people with disabilities;
- to make content apprehensible and navigable;

- to use a clear and simple language;
- to provide navigation tools and orientation information in pages, maximizing accessibility and usability.

The information on the site are organised in the following main categories: about the site (destination; accessibility, site map, metainformation); assistive technologies (a guide to selection, principles and practice, resources); legislation; documents; electronic record; useful addresses (for vocational rehabilitation and integration, also including legal and medical advice); additional information (travel facilities for disabled persons, social security, hospitals and clinics offering recovery treatments); useful links; forums to exchange messages on any topics of interest.

A great attention was put on the accessibility of the site. If a site is not accessible, it will lose millions of visitors not just those who have disabilities, but also those who work with and otherwise support the accessibility community.

We analyzed the Inhand Web site traffic, using WebTrends Log Analyzer, over a period covering 2 years. The results show a linear increase in the access to the Inhand web site.

IV. Discussion

We have tested the InHand site accessibility using some accessibility validation tools (Wave, Bobby) and testing with multiple browsers for a variety of conditions (Internet Explorer and Netscape under Windows and the browsers Mozilla and Konqueror under Unix). First end-user reports are positive. We are preparing also a sound dissemination programme to make people aware of the existence of the site (mass-media, leaflets, other web sites etc). To note that the success of the application is directly determined by the access of the target population (here PwD) to Internet.

V. Future Developments

The new project of our team, „PRO-INCLUSIV - Methods and tools to create multimodal interfaces for the development of inclusive information systems, with high degree of accessibility", will create a core task force for the development of inclusive information systems, serving as a basis for a future network of excellence at national level and will address two great challenges of the information society:

- Social and economic integration of people with (different degrees) of visual impairment by the development of multimodal interfaces and implementation in information systems.
- Improvement of interactive systems design practice through the promotion and development of user centered design methods, under the "universal design" or design-for-all paradigms, with the purpose to render the information technology usable for as many people as possible and with reduced costs.

In this respect, the design-for-all approach is addressing a broad spectrum of users, including elderly, disabled people, people with low educational level, as well as people that are not able to make use of their abilities due to a particular context of use: limitations of the activity, special situations, social and physical environment, and equipments.

PRO-INCLUSIV will create a forum of collaboration and debate for all actors involved in the prevention of the digital divide: different categories of users, professionals in information technology, psychology, special psycho-pedagogy, associations, nongovernmental organizations, and institutions of the central and local public administration.

VI. Conclusions

The InHand application complies with the WAI - Web Content Accessibility Guidelines 1.0, priority 2. The InHand project results meet the requirement of a largely uncovered area in Romania: keeping informed persons with disabilities. The InHand database is an attempt to bring together potential assistance beneficiaries and potential assistance providers.

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eHealth and Digital Medicine in the Virtual Hospital of the Future

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Abstract- Solutions for the interoperability of the various medical services offered by different institutions are needed. Therefore the creation of a Virtual Euro-Mediterranean Hospital for a real integration taking into account cultural differences is proposed. Pre-operative planning, minimally-invasive medicine, etc. require a digital and virtual environment supporting the perception of the physician. A satellite-based and terrestrial platform allows for e-Learning, real-time telemedicine and medical assistance. Due to the distributed character of the virtual hospital Grid technology becomes important.

VII. INTRODUCTION

Telemedicine aims at equal access to medical expertise irrespective of the geographical location of the person in need. New developments in Information and Communication Technologies (ICT) have enabled the transmission of medical images in sufficiently high quality that allows for a reliable diagnosis to be determined by the expert at the receiving site [1-3]. At the same time, however, these innovative developments in ICT over the last decade bear the risk of creating and amplifying a digital divide in the world, creating a disparity between the northern and the southern Euro-Mediterranean area.

The digital divide in the field of health care has a direct impact in the daily life of the citizens and on their quality of life. In recent years, different institutions have launched several Euro-Mediterranean telemedicine projects. All of them aimed to encourage the Euro-Mediterranean cooperation between the European member states and the Mediterranean Countries.

All these projects have demonstrated how the digital divide is only a part of a more complex problem, the need for integration. Therefore, provision of the same advanced technologies to the European, to the Mediterranean and to the Adhering Countries should be the final goal for contributing to their better dialogue for integration.

In the framework of the EMISPHER project (Euro-Mediterranean Internet-Satellite Platform for Health, medical Education and Research, EUMEDIS Pilot Project 110, see www.emispher.org/, 9/2002-12/2004, co-funded by the EC under the EUMEDIS Programme) a dedicated internet-satellite platform for Telemedicine in the Euro-Mediterranean area was deployed and put in operation [4]. The network currently consists of 10 sites in Morocco, Algeria, Tunisia, Egypt, Turkey, Italy, Greece, Cyprus, France and Germany, (see Fig. 1) and hosts key applications in the field of medical eLearning (courses for under-graduates, graduates, young medical professionals, etc., in real-time and asynchronous modes), real-time Telemedicine (second opinion, demonstration and spread of new techniques, Telementoring, etc.) and eHealth (medical assistance for tourists and expatriates). The EMISPHER network serves as a basis for the development and deployment of a Virtual Hospital for the Euro-Mediterranean region.

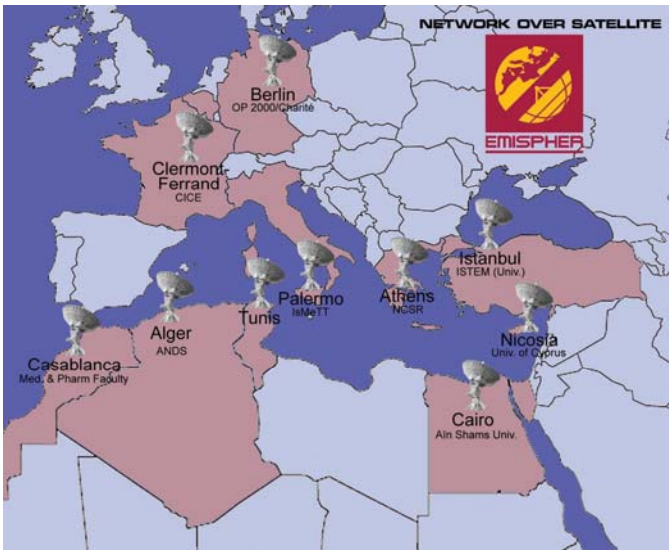

Fig. 1: Centers of Excellence in the EMISPHER Network

VIII. MATERIALS

For the realization of global health care dedicated 24/7 telemedicine and e-Health services are needed. These services should meet reliable and high quality of service (QoS) constraints. Open source and open standard solutions are needed for interoperability and integration of the various services offered by different institutions and gateways to

other communication networks should be created. Implementation of remote control of medical devices will enhance telediagnosis and help to realize an equal access to medical expertise irrespective of the geographical location of the person in need. The medical workflow and decision-making tree has to be re-evaluated and new management tools and strategies for global virtual alliances have to be introduced. Mental, intellectual and educational e-services for the citizens shall be created [5]. In the EU in the area of e-Health until the year 2008 Electronic Health Records, Electronic Health Insurance Cards, Europe-wide patient identifiers, Interoperability of the various cards, Medical e-Learning for health professionals, Harmonisation of reimbursement and liability issues and European Public Health Portal for citizens will be realised.

Due to the experience in the exploitation of previous European telemedicine projects and, in particular to activities carried out in the framework of the EUMEDIS programme, an open Euro-Mediterranean consortium would like to propose the Virtual Euro-Mediterranean Hospital (VEMH) initiative.

VEMH aims to facilitate and accelerate the interconnection and interoperability of the various services being developed (by different organisations at different sites) through real integration. This integration must take into account the social, human and cultural dimensions and strive towards common approaches but open and respectful of cultural differences: multi-lateral cooperation instead of aid.

IX. Results

Pre-operative planning, navigation and robotics offer advantages e.g. in minimally-invasive surgery by increasing the precision and shortening the recovery time of the patient. As minimally-invasive surgery is image guided it requires an adequate fully digitized environment for optimized usage in clinical routine. Navigated instruments support surgical operations in neurosurgery, craniofacial or liver surgery, etc.

All these areas produce an information flood. To deal with such an amount of information, personalized avatars to represent the user virtually in an online community of medical information systems and multi perception for multi media performance in virtual reality environments (visualisation of virtual 3-D objects, full navigation, haptic simulation, etc.) are needed. It is hypothesized that multi-modal stimulation in virtual environments raises the experience of presence perceived by the user. Thus a multimedia and multimodal data display supports perception of the user effectively (Fig. 2).

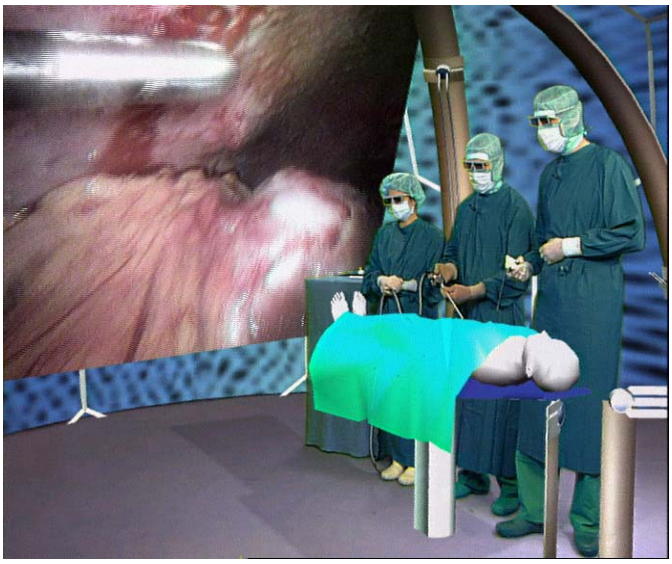

Fig. 2: Cyberspace Surgery in a Virtual Training Environment

Information and Communication technologies (ICT) contribute to digital radiology, digital pathology, telemedicine and navigation and simulation. New developments in ICT have enabled the transmission of medical images (both still images and live video sequences) in a sufficiently high quality to allow for a reliable diagnosis to be formulated by the expert at the receiving site. Real-time telemedicine refers to those applications that involve live transmission of medical data and concomitant live teleconsultation of the remote expert. Successful real-time telemedicine applications exhibit several key factors such as sufficiently high communication bandwidth that is also economically affordable and intelligent data compression modules that allow for drastic reduction of the required bandwidth. In radiology the use of digital, filmless radiology information systems is now standard. For digital pathology a digital virtual microscope must scan the slides at the highest possible magnification and generate images on a PACS server. Image sizes are still large but the vast progression in data storage allows managing this level of data. The system's advanced functionality is likely to enable introduction of digital pathology in routine diagnostic work in near future. However, the promise of telemedicine to provide equal access to medical expertise irrespective of the geographical location can only be met when not merely the patient's data are transferred but rather a telepresence is created bringing patient and remote expert together using ICT. Besides general interactivity between the two sites features like telehaptic, telesensation and remote control of medical devices (e.g. telerobotics) are prerequisite for a real telepresence.

For treatment according to verifiable guidelines according to the concept of evidence-based medicine an optimization of the clinical workflow is necessary. Workflow management will specify the technical realisation of medical sequences of operations. Here the integration of the different modalities (imaging, medication, OP-report, etc) into a centralized electronic patient record is needed. The electronic patient record has the potential to improve the communication in

health care and consequently the quality of treatment and to save a lot of money.

The Virtual Euro-Mediterranean Hospital (VEMH) is dedicated to bridging a digital divide by establishing high quality equal access to real-time and on-line services for healthcare for all of the countries of the Euro-Mediterranean area. VEMH will provide a heterogeneous integrated platform consisting of a satellite link, such as in the EMISPHER project, and a terrestrial link, like in the EUMEDCONNECT project, for the application of various medical services.

F. VEMH Services and Activities

E-learning. In the project the Mediterranean Medical University (MeMU) will be developed. The leading medical centres integrated in the network provide pedagogical material and modules for synchronous and asynchronous e-learning in their medical specialties. The central gateway to MeMU is an integrated satellite- and terrestrial-based platform and will provide the users with access to various contents in the network and support the participation in real-time e-learning events (Fig. 3).

Real-time telemedicine. VEMH will offer the following categories of applications:

- second opinion,
- tele-teaching & tele-training (demonstration and spread of new techniques),
- tele-mentoring (enhancement of staff qualification),
- undergraduate teaching courses
- optimisation of the learning curve.

These real-time interactive telemedical applications contribute to improved quality of patient care and to accelerated qualification of medical doctors in their respective specialty (see Fig. 4). Thus, this international network of distributed but integrated competence contributes directly and indirectly to improved healthcare.

Fig. 3: Interactive Multipoint E-Learning session with real-time transmission of ultrasound (US) video from Charite – Berlin to University of Cyprus and Ain Shams University – Cairo

Medical assistance. As tourism constitutes a substantial economical factor in the Mediterranean region and because of the increasing mobility of the population, continuity of care through improved medical assistance is of major importance for improved healthcare in the Euro-Mediterranean region. The introduction of standardised procedures, integration of the platform with the various local and national communication systems, and training of the medical staff involved in medical assistance allow for shared management of files related to medical assistance (medical images, diagnosis, workflow, financial management, etc.) and thus for improved care for travelers and expatriates in the Euro-Mediterranean region.

Fellowship programme. VEMH will offer individual grants to young medical doctors coming from the Mediterranean and from accession countries. Each fellow will be trained in one of the fields of the MeMU through the tele-teaching and tele-training VEMH services. This training programme will include an internship period in some of the clinical and scientific institutions of the VEMH consortium. The VEMH faculty will constantly monitor the progresses of the fellows and will evaluate them at the end of the training period. The scope of the fellowship programme is to allow young medical doctors to develop and gain experience in a multicultural and multidisciplinary environment.

G. Methodology of the VEMH

The methodology in the VEMH medical network of competence will be improved by the realization of a management of the clinical outcomes. By the integration of different telemedical solutions in one platform it will be possible to support many different medical applications which can be arranged in a matrix structure where the individualisation of the user needs per country are represented as matrix columns and the applications with integrated technological solutions are represented as matrix rows. A criterium for the selection of applications are low access costs.

The VEMH provides a modular distributed medical network for integration and optimisation of various applications. The developed new methodologies and applications should be useable for more than one disease. The methodologies of the VEMH are medical-need-oriented instead of technology-driven.

H. Evaluation and Assessment of VEMH Services and Applications

The justification of the various VEMH services and applications will be assessed by using a comprehensive evaluation methodology. This will in particular examine various outcomes including clinical, organisational, and economic as well as other relevant outcomes. The criteria

under which such services can be evaluated are based upon the work of Bashshur (1995) [6]. The rationale for using this type of methodology is to ensure that the services or applications are capable of having an immediate and positive impact upon patient care in the VEMH region.

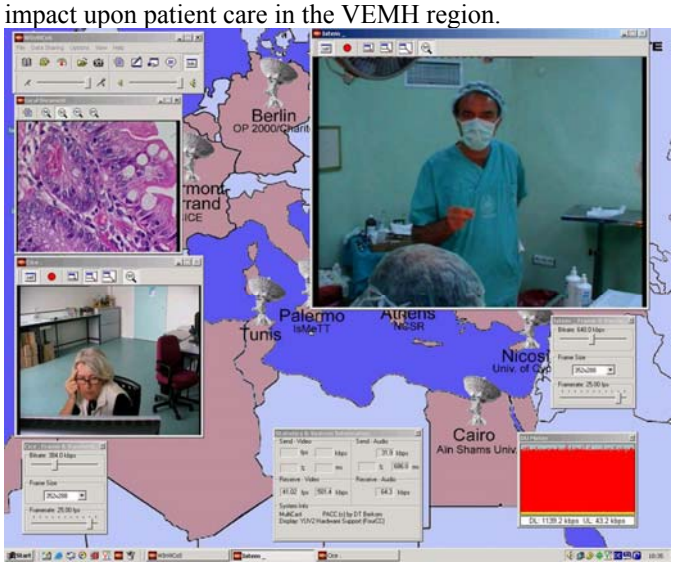

Fig. 4: Interactive Telepathological Teleconsultation between Istanbul Medical Faculty and CICE – Clermont-Ferrand

I. VEMH Outcomes

VEMH will foster cross-Mediterranean cooperation between the leading medical centres of the participating countries by establishing a permanent medical and scientific link. Outcomes of the VEMH are guidelines for different diseases in the different medical fields presented in standardised way, education on these new standards for all users and future users, new e-learning interactive tools and quality control and score of quality. Benefits of the VEMH are increased effectiveness, accelerated decision making, improved quality of decisions via real-time global exchange between experts reducing the travel and integration of the human resources in this region.

J. Grid Technology

Due to the distributed character of the VEMH, data, computing resources as well as the need for these are distributed over many sites in the Virtual Hospital. Therefore Grid becomes inevitable for successful deployment of services like acquisition and processing of medical images, data storage, archiving and retrieval, data mining (especially for evidence-based medicine) [7-8]. To achieve this conventional Grid technology has to be expanded to cover not only local computing resources but to a dimension of organisation spanning integrated networks.

X. CONCLUSIONS

VEMH will foster cross-Mediterranean cooperation between the leading medical centres of the participating countries by establishing a permanent medical and scientific link. Through the deployment and operation of an integrated satellite and terrestrial interactive communication platform, VEMH will provide for medical professionals in the whole Euro-Mediterranean area access to the required quality of medical service depending on the individual needs of each of the partners. For the successful deployment of the various medical services in the VEMH the development and implementation of Health Grid technology appears crucial. The applications in the area of E-Learning, Real-Time Telemedicine and improved Medical Assistance contribute to an improved health care in the Euro-Mediterranean area and build the basis for the introduction of evidence-based medicine.

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Telecare in Singapore Health Services

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Abstract - This paper describes and discusses Home Telecare initiatives in Singapore Health Services (SingHealth). The outpatients with chronic diseases using the system are:

- Chronic heart failure patients and heart transplant patients
- Pregnant patients with diabetes
- Pregnant patients with gestational hypertension
- Peritoneal Dialysis Patients

The Telecare system provides timely and personalised outpatient care anytime, anywhere by empowering outpatients outside of SingHealth medical facilities to use ubiquitous technologies such as low-cost health monitors and Internet Telecare portal or mobile phone text messages (SMS) to update their daily health status for SingHealth clinicians to review and intervene (if necessary) to reduce complications/emergencies. By using the system, clinicians are also able to actively finetune the medication of their outpatients depending on their recent health status. The system also assists clinicians to extend their reach and care to overseas patients, and traveling patients (who are not able to attend regular reviews in person). The system empowers clinicians to customise and individually set vital signs thresholds and symptom questionnaire for each of their patients. When a patient's vital signs are abnormal, their clinicians are alerted via SMS. Clinicians can also view a patient's health progress through interactive informative charts. The Telecare portal also provides a secure messaging module for the patient and clinician to communicate with each other. For urgent messages, clinicians can SMS the patient immediately through the portal. The system is developed in-house using Microsoft .NET with a scalable object-oriented design. Infrastructure/application security features and audit trails have also been implemented to protect patient's privacy and data. The system can handle patients with comorbidities (more than one chronic disease). Telecare is a possible long-term solution to use information technology to provide long-term care for the rapidly aging population and the rise of chronic degenerative diseases. Singapore Health Services (SingHealth) consists of a cluster of 3 Hospitals, 5 National Specialist Centers and a network of primary healthcare clinics (polyclinics) distributed around the east side of Singapore providing public healthcare. Each year, SingHealth attends to 3 million patients.

Keywords: Telecare, chronic disease, remote monitoring, personalized care

I. Background and Introduction

The Singapore public healthcare delivery system is organized into two vertically integrated delivery networks, Singapore Health Services (SingHealth) and National Healthcare Group (NHG) [1]. The public healthcare system provides 80% and 20% of hospital care and primary care respectively. The remaining portion is provided by private hospitals and private practitioners. Each year, Singapore also attends to more than 200,000 overseas patients [2].

SingHealth consists of a cluster of 3 Hospitals, 5 National Specialist Centers and a network of primary healthcare clinics (polyclinics) distributed around the east side of the country. Each year, SingHealth attends to 3 million patients [3].

Singapore has a rapidly aging population, with the proportion of those 65 years and above estimated to increase to 19% of the population by 2030 [4]. This growth will spur a quantum increase in the demand for healthcare services and chronic disease management. Hence, there is a need to improve the health of the elderly and strengthen the management of the main chronic diseases. Within the population, with the rising affluence and the proliferation of healthcare information, there is also the rise of the "expert patient" - patients who are health and tech savvy.

With the rapid progress of technology, the cost of personal telecommunication links has come down to an affordable level, with 65% of Singapore households having Internet access [5], 44% of Singapore households with broadband access, and more than 90% of the population having mobile phones [6]. Progress in technology has also enabled the availability of affordable, portable personal digital healthcare monitors.

In response to the aging population, rising patient expectations, affordable technology and ubiquitous infocomm infrastructure , the time is ripe for SingHealth to embark on pilot trials for home Telecare. The objectives of the Telecare system is to enhance patient care by providing channels for outpatients to regularly send their vital signs and symptom data to SingHealth clinicians to monitor and advise appropriate actions. Through this regular monitoring, consultants/clinicians can:

- Identify early each outpatient's health trends between clinical appointments,
- institute early treatment to reduce/prevent hospitalization and emergencies,
- refine outpatient's medication dosage to control disease between clinical appointments.

Depending on the disease and severity, periods between clinical appointments can vary from weeks to months.

The success of these expected outcomes of Telecare have been well documented in the literature [7,8].

By "virtually" assisting the outpatients to stabilize their chronic disease, Telecare enables them to actively participate in everyday life, engage in fruitful economic activity and be reassured that their health status is timely managed.

For patients without homecare or Telecare services, a deterioration in the patient's health condition between clinician visits would go undetected and more emergencies may arise, thus escalating cost and demand for healthcare services. This also translates to added cost to patient and public healthcare services.

II. PROJECT OVERVIEW

Prior to the Telecare project, SingHealth clinical departments with chronic disease patients have administered some form of homecare services for selected patients. These services are managed by nurse clinicians who regularly/periodically monitor patients who either fax in or call in to report their health status. Nurse clinicians will sieve through the received data and highlight patients with problems to doctors to intervene. Although this service has helped patients, this process may not be able to handle large patient pools, and past data is not easily retrieved for review/diagnosis.

To provide homecare to more patients, a Telecare system was developed in-house by SingHealth staff for:

- Chronic heart failure patients and heart transplant patients. Heart disease is the second biggest killer in Singapore. Through monitoring of patients, the Telecare system may assist to stabilize outpatients and prevent/reduce hospital admissions. Outpatients transmit their self-administered blood pressure, pulse oximetry, weight, heart rate, in/out readings on a regular basis to the Telecare system. The types of vital signs required for monitoring and frequency of monitoring depends on the severity of the disease and is advised by the patient's doctor.
- Pregnant patients with diabetes [10]. Diabetic pregnant women or women with gestational diabetes require intensive monitoring and tight glucose control, as these have been shown to translate into good pregnancy outcomes. Outpatients transmit their self-administered blood glucose data and insulin intake to the Telecare system. Telecare is ideal for these outpatients as:
  - they require close monitoring between their regular checkups,
  - patients are young and tend to be tech-savvy,
  - patients are motivated to comply with doctor's instructions.
- Pregnant patients with gestational hypertension. Non-proteinuric pregnancy-induced hypertension (PIH) patients are managed as outpatients but require regular, close follow-up as they may progress to pre-eclampsia which requires inpatient care. Outpatients transmit their self-administered blood pressure data and urine protein test results to the Telecare system. Telecare is also ideal for these patients due to their patient profile.
- Peritoneal Dialysis (PD) Patients. In Singapore, about 23% of renal failure patients self-administer PD at home [11]. These patients may encounter medical problems like infection, hypotension (low blood pressure) at home. Telecare monitoring helps clinicians to monitor their progress without physical outpatient visits to the hospital. Patients transmit their weight, blood pressure, dialysis ultrafiltration information, blood sugar, and some critical symptom data to the Telecare system.

Since October 2005, pilot trials were conducted for selected pool of patients with these chronic diseases [12][13]. The objective of the pilot trials is to refine clinical processes for each disease, evaluate patient's and clinician's feedback/response to Telecare.

Organisations involved in the pilot trials are:

- National Heart Center, Singapore
- Department of Obstetrics & Gynaecology, Singapore General Hospital, Singapore
- Department of Renal Medicine, Singapore General Hospital, Singapore

Telecare is also particularly useful for our overseas patients, and patients who travel frequently where scheduling regular physical review visits may be difficult. For the project pilot, there are overseas patients from a neighbouring South East Asian country using the Telecare system. (In South East Asia, mobile phone access is conveniently available in most areas as compared to Internet access.)

In the pilot trials, the patients' ages range from 22 to 56. The patients are multi-racial and come from a diverse background

The project was funded by SingHealth's Innovative Technology Application Group (iTAG) grant. The iTAG fund is a SingHealth development fund through which clinicians can receive funding to work with IT staff to develop and pilot innovative information technology applications in healthcare.

This Telecare project has been reviewed by the hospital's ethics board. A risk mitigation analysis of patient safety was also conducted. Patients using the system are also required to sign a legal patient consent form with the hospital.

Due to the experience in the exploitation of previous European telemedicine projects and, in particular to activities carried out in the framework of the EUMEDIS programme, an open Euro-Mediterranean consortium would like to propose the Virtual Euro-Mediterranean Hospital (VEMH) initiative.

VEMH aims to facilitate and accelerate the interconnection and interoperability of the various services being developed (by different organisations at different sites) through real integration. This integration must take into account the social, human and cultural dimensions and strive towards common approaches but open and respectful of cultural differences: multi-lateral cooperation instead of aid.

III. TELECARE FEAUTURES

Outpatients using the Telecare system, will regularly send in their vital signs data and/or selected symptoms from home or locations external to SingHealth computer networks through the Internet portal or mobile telephone network (through SMS). The frequency and time interval between each set of vital signs data is decided by the patient's clinician.

When a patient's vital signs and/or selected symptoms are beyond the vital signs thresholds set by their clinician, a SMS alert is sent to the clinician responsible for the patient. The patient also gets an alert message via the channel that he/she is sending the data. All vital signs thresholds and alert messages to patients can be individualized and customized by the clinician for each patient.

Upon receipt of an alert message, the clinician will acknowledge the alert by SMS, and execute appropriate actions. If the system does not receive an acknowledgement from the clinican, the alerts are re-sent at regular intervals until the clinician acknowledges receipt of the alert. Clinicians can choose to be alerted or not alerted for each patient they are responsible for. Clinicians can review patient's progress charts and data from the Telecare system.

For patients sending in their data through the Internet, the patients may also be required to answer a symptom questionnaire. As a patient's health status cannot be completely indicated by health monitors, the symptom survey provides the clinician with more information for diagnosis. The set of symptom questionnaire is customizable by the clinician for each patient or a group of patients.

The Telecare portal also provides a secure messaging module for the patient and clinician to communicate with each other. Through this module, patients can:

- Inform clinicians of activities they have undertaken that may have affected their data.
- Inform clinicians of changes in diet that may have affected their data.
- Send queries to clinicians to clarify doubts/actions about managing their diseases. This is particularly useful for patients who are new to the disease, or have just been discharged from the hospital and managing their disease on their own.

Messages are limited to 500 characters. Clinicians will act on patient's messages appropriately such as sending their replies through the Telecare system. For urgent messages, clinicians can SMS their patient through the portal instead of waiting for the patient to login to view their replies.

The secure messaging feature provides a virtual "human touch" through timely replies from clinicians to problems raised by outpatients. This educates outpatients to rapidly adapt and manage their disease, or check-in for an earlier physical medical review. Clinicians may also use the secure messaging feature to encourage their patients when their health status is good. Such encouragement reassures patients who have good health status that their Telecare data are reviewed by clinicians in a timely and regular manner, even when they are performing well.

IV. INFOCOMM INFRASTRUCTURE

An in-house developed system (Sirius) was developed to support the Telecare project. Some of the objectives of the system were:

- Provide individualized, personalised remote care
- Convenient to use and user-friendly.
- Affordable, preferably low cost.
- Use low-cost and user-friendly healthcare monitors.
- Require minimal training for clinicians and patients

Sirius provides a web portal with the following features/modules:

- Patient Module. For Patients to enter their data and review their progress. All patient communication is through secure sockets (HTTPS).
- Clinician Module. For clinicians to review patient's vital signs and symptom data/trends through interactive graphs and raw data. The home page for each clinician conveniently summarizes the list of patients with recent vital signs alerts for clinicians to act. For security purposes, this module is only accessible from the SingHealth intranet or through secure thin client with two-factor authentication.
- Threshold and Alert Module. For clinicians to set personalised vital signs thresholds for each patient, and customized alert messages to patients.
- Secure Messaging Module. For patients and clinicians to communicate with each other. Patients

and their clinicians can track replies to each message/query from patient.

- Patient/Clinician Administration Module. For each clinician or patient, the Sirius database keeps only one user record. The system provides a single-login for patients with comorbilities or clinicians handling patients with different problems (e.g. Obstetrics and Gynaecology).
- Multi-mode Communications. The team has chosen to provide a multi-mode communication platform so that patients can choose the most convenient mode of sending their data. Like all IT systems, ease of use is very important for mass user adoption. Besides the Telecare portal, simpler human communication interfaces such as mobile phones and touch-tone telephone can also help to bridge the digital divide.
    - Short Message Service (SMS) module. To receive patient's data and generate clinician alerts. The mobile phone is portable and more than 90% of the population has one.
    - Touch-tone telephone module. This low-cost communication channel is particularly useful as a large portion of our elderly patients can use this service without purchasing a computer or mobile phone. In multi-racial Singapore, this channel also works well for elderly patients who only understand other languages or dialects. This module will be operational in the second quarter of 2006.

Hence, the Telecare service can be used "anytime, anywhere, in the way the user is most comfortable with".

- Security. In order to protect the patient's data, efforts were also made to security harden Sirius through efforts such as server hardening, vulnerability tests, software mechanisms such as session hijacking prevention, encryption of the query string using random keys, and hidden application directory structure during browsing. All clinician/patient actions on the system are also logged for audit trail purposes.

Sirius was developed in C# using Microsoft .NET Framework. The system was developed from scratch by a team of two iTAG staff. Development work was completed in 5 months. The project cost is less than US$50K, mainly used to purchase servers, hardware and software development tools. The use of object-oriented programming methodology and web services helps rapid development through reusability of code, inheritance and encapsulation. Hence, new diseases and functionalities for Telecare can be easily added to Sirius. A new disease can be added within 2-3 weeks.

To complement Sirius, a vital signs datalogging system (Sirius Flash) was also developed. Sirius Flash is a PC-based system that can communicate directly with healthcare monitors to receive vital signs data. Sirius Flash will send this data to Sirius through the Internet. The patient need not key in the data into the Telecare system. This eliminates transcription errors and is convenient for the patient. Sirius Flash works with commercial vital sign monitors that measure heart rate, blood pressure, temperature, pulse oximetry, blood sugar and weight. Sirius Flash sends data to the Sirius through web services. It is hoped that in the future, that Sirius Flash be installed as Telecare kiosks in polyclinics conveniently located around the island to bridge the "digital divide" so that Telecare can be easily accessible to all.

As technology advances, healthcare monitors will converge with the mobile world though health-status enabled mobile phones[14] or wearable embedded monitoring devices with interfaces to the mobile phone network[15][16]. By just adding new communication adapter interfaces to Sirius for these new devices, our initial investment in Sirius can continue to serve our patients well into the future.

V. PATIENT COMPLAINCE

For any home Telecare system to be successful, patient compliance to clinician's instructions and accurate measurements are important. The team also acknowledges that for the success of the system with elderly patients, the data may be entered with the assistance of their caregivers or family members. The following steps were taken to assist in patient compliance in using the system:

- Training. Before using the system, the patients and/or care-givers are trained to correctly use the relevant healthcare monitors (such as blood pressure meter, glucometer, etc) to measure their vital signs. Patients are also trained to use the various channels of sending in their vital signs data.
- Data Review. Patient's data are reviewed daily. Data anomalies are identified and clinicians will contact patients to verify data. For patients who have problems obtaining accurate results, they will be re-trained by the nurse clinician.
- Schedule Review. For patients who do not regularly send their data, verbal phone reminders are made by the nurse clinician.

For the safety of the patients, patients are also instructed:

- to call their respective clinical department if they are not able to send their data (e.g. system failure or personal activities)
- to seek medical help immediately if at anytime they experience sudden medical difficulties.

VI. CONCLUSION AND FUTURE WORK

The system was launched in October 2005. Ongoing feedback received from clinicians and patients will be used to refine the system and clinical processes so that more patients can use the system in the future. Response from clinicians and patients involved in the trial have been encouraging and favourable; useful suggestions to enhance the system were implemented. Patients have also benefited from the interventions made by clinicians when they have problems. The secure messaging module with clinician SMS feature was well-received.

Besides actively seeking to pilot the system with other types of chronic diseases, the team will also launch a touch-tone telephone channel in second quarter 2006. This low-cost communication channel is particularly useful for patients who are not tech-savvy, and/or only understand non-English languages.

In order for the system to benefit more SingHealth patients in the future, the following work will have to be done:

- An affordable and sustainable business strategy for Telecare service, and patients are charged an appropriate fee.
- Implement new Telecare processes and protocols to augment hospital processes to meet clinical service levels for Telecare.

For our current Telecare pilot projects, we are focusing on the following:

- *Monitor* patient's health *progress* and intervening when the patient's health status is beyond their personal thresholds, eg. heart failure patients.
- *Moderate* patient's medication to *promote* their health by intervening regularly to assist patients to improve their condition through fine-tuning their medication, eg. gestational diabetes patients.

We are excited of the many possibilities and potential of personalized Telecare for a rapidly ageing population, and with the rapid advances in technology, we envision a day when we will be able to not only remotely monitor our patients, but also through technology, remotely *modify* their medication to *promote* their health, i.e. Telecare.

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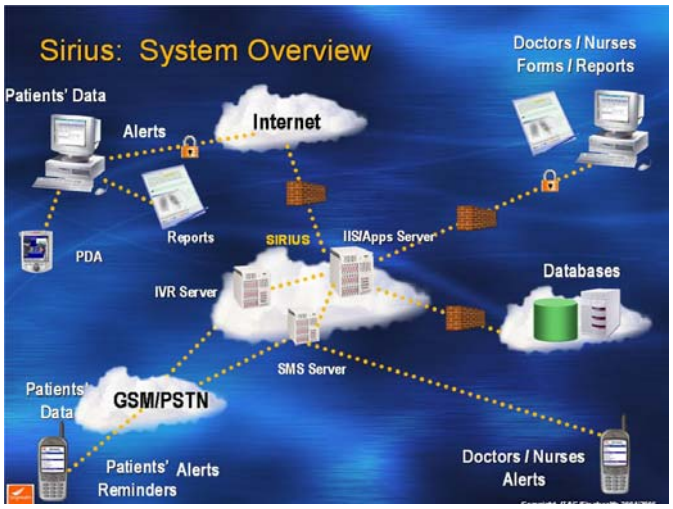

Fig. 1: System Overview of SingHealth Telecare system (Sirius)

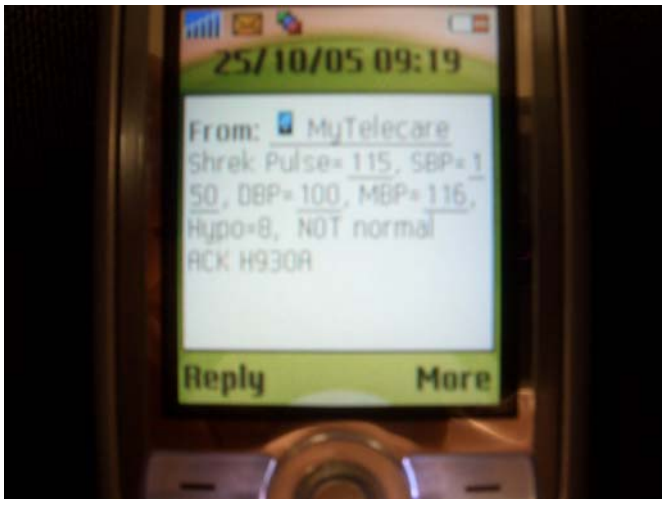

Fig. 2: SMS alerts immediately received by clinician's mobile phone when patient's vital signs are not normal. In this case, patient name is Shrek. His heart rate, systolic blood pressure, diastolic blood pressure, mean blood pressure and blood sugar readings are not normal.

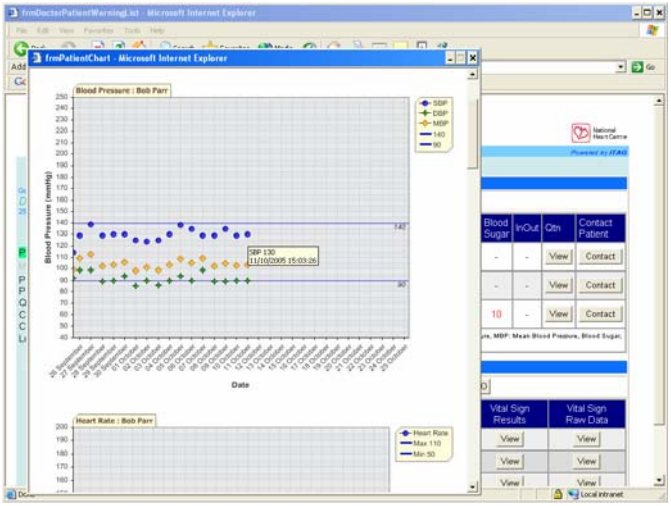

Fig. 3: Interactive charts of health progress of patient. Data numeric values may be obtained by moving mouse over the data points on the chart.

A Home Care System used in post-operative patient management

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Abstract- The scheme described in this paper presents a home care system used in the eTEN-project INTERLIFE (www.interlife-project.net) and based on the technological development of the CHS project. INTERLIFE provides an innovative model of healthcare services based on a technologically assisted early discharge procedure and a continuous home monitoring service. Technological objectives concern the development of new generation telemedicine services and the integration of telematics technologies, data acquisition devices, educational material interfaces, data security and data fusion. Health care based objectives address cost effectiveness and citizen involvement in health care delivery, as well as opportunities for better diagnosis to the clinical staff. Following these objectives, a home care system has been designed that combines initial screening, measurement devices, patient education, decision support, appropriate telephone/WAP/WWW contacts and physician access. The system architecture follows a 3-tier model. Three different technologies have been chosen exemplary for the patient interfaces, so that patients may choose the communication means of their preference: Computer Telephony: Fully automated telephone Contact Center, Wireless Technology: WAP, WLAN/GPRS, Internet. The system was tested in three different clinical trials for the management of diabetes, congestive heart failure and post trauma patients. In the case of the post trauma trial, after surgical intervention patients are trained in operating the home care unit (Tablet PC with WLAN/GPRS network connection) and instructed to their treatment plan and medication. After early discharge, essential data about the clinical status of each patient are obtained through a personalized questionnaire on a daily basis. A home care agency provides wound documentation. The relevant patient data is sent to the clinical unit using GPRS technology. The surgeon can remotely monitor the postoperative course, which allows precise documentation of the healing process and quality assurance. The current system was developed, following the hypothesis that individualized telemonitoring, patient education and self-care empowerment can substantially reduce the length of hospital care without compromising medical safety and outcomes. Multiple means of communication are offered, thus a high ration of the patient population can be included. This increases patients' involvement in their own health, and hopefully reduces the need for hospitalization. Furthermore, the personal profiles, customized to user's needs, contribute to customization of health care delivery. The system is flexible, allowing incorporation of new communication technologies, such as UMTS, with little development effort, thus serving the idea of an integrated system for health care delivery.

Keywords: home monitoring service, patient education, ubiquitous computing

A Programmable Multimedia Homecare Assistant

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Abstract-The issue of telemedicine integration into routine medical practice is a very promising one by approaching the concept of *programmable multimedia homecare assistant (PMHcA)*. This idea extends the current concept of patient terminal that is one of the most challenging parts. This paper addresses the basic statement to create a standard platform for the in-house patient terminal fusing different available technologies and services. Our contribution is focused on the implementation of a friendly user unit as a personal healthcare assistant, 24 hours a day accessible by chronic patients. The concept aims to implement a particular homecare service in order to bring and maintain the doctor and chronic patient closely between the regular consultations. This study is mainly based on the family doctor practice, which really creates the opportunities for a various medical services in terms of telemedicine.

I. Introduction

Many tasks in current practice of a family doctor are focused on chronic patients with one or more diseases like Arterial Hypertension, Coronary Heart Disease, Cerebral Vascular Accident (CVA), Chronic Renal Insufficiency, Diabetes mellitus, as well as Heart Rhythm Disorder. Generally, the doctors have to prescribe the complex schema of treatment as well as the specific hygiene-dietetics recommendations. Usually, a lot of information regarding the treatment administration and additional medical advises related on the side effects, precautions, and alternate medication must be communicated to the patient. An important complementary part of doctor-patient communication content also consists in the information about his or her ill and suffering. A tremendous counseling work should be done by doctors in order to make the patient aware of his or her sickness and disorders, determining him or her to adopt an adequate particular life style. On one hand, the doctors perform all these spending a lot of effort on writing prescriptions in association with more or less detailed oral explanations, which are frequently repetitive and obviously chronophague. On the other hand, the patient should go home with a specific, complete, clear and dedicated package of medical information. In practice for many patients including those ones with special needs, it is proved that only a small part of this information becomes effective into the ambulatory. The reasons for that are diverse and foreseeable, but for engineers and doctors, this is an opportunity to develop new applications of telemedicine in order to provide better homecare assistance. Under these circumstances, we consider a useful effort to extend the telemedical application towards a real medical counseling of the chronic patients especially of the elderly ones. We also propose a way to implement a standard terminal to make the telepresence in doctor-patient relationship more effective.

II. Medical Context Definition

K. The relevant target group

This section highlights the relevant context in the medical practice that determines the introducing of the proposed homecare assistant concept. In this study, we refer the data coming from roughly 1700 patients registered on the list of this paper's co-author as a family doctor. We mention that almost all these patients live in urban area, in an old residential quarter, which explains the high percent of elderly persons (roughly 460 are older than 65). An image about chronic cases of this doctor is given by data in Tab.I.

TABLE I
Diseases in Data

Disease	Numeric	%
Arterial Hypertension	380	22.3
Cardiac Ischemia	277	16.3
Diabetes	63	3.7
Cerebral-vascular Diseases	46	2.7
Chronic Liver Disease	32	1.8
Endemic Goiter	38	2.2

This work is supported by the national grant Multimedia Platform for Implementation of the Complex Medical Teleservices (TELMES). (http://www.telmes.ro)

Tumor	29	1.7
Mental disabilities	19	1.1
Epilepsy	8	0.4
Obstructive and Nonobstructive Lung Disease	8	0.4
Ulcer	8	0.4
Chronic renal insufficiency	5	0.3
Total diagnosed patients	913	53.7

Focusing on the most frequent and spreader disorder in the world, we refer here to the disease with the highest rate of death that is heart disease. Under this circumstance, the hypertension is the major health disorder that is estimated affecting 20-25% of people in the world. As it is well known, untreated hypertension evolves towards serious illness like Acute Myocardial Infarction, Cerebral Vascular Accident, The Nephropathy of Hypertension, etc. Fig. 1 presents the candidate target organs of hypertension effect as it is synthesized in [4]. On one hand, hypertension cases usually become complex because of some associated disorders like Diabetes and Renal Insufficiency. On the other hand, the age of the patient is an important issue that complicates the case.

The recent statistics show hypertension is between 50% and 70% at the people of over 65 years old. Other social and psychological factors complete the target group's profile.

In this study our interests are focused on a typical patient's clinical profile and frequently meet in family doctor's routine defined as follows:

- arterial hypertension over 140/90 mmHg;
- elderly person (over 65);
- complications: diabetes;
- walking difficulties.

Based on the data in Tab.I we note that hypertension is around 41% from chronic cases, including 380 patients. Roughly, 3/4 of them are elderly patients over 65 years old, which are thus 285 cases. About of 20% of these cases are diabetics that mean 57 patients belonging to above defined clinical profile. As a mater of fact, our interest group makes up to 6% from chronic patients.

L. Drugs prescription and conducting rules

In practice, the hypertension disease is the subject of management having the main objective to prevent the cardiovascular complications. This involves specific actions as is following:

- The identification of all the reversible risk elements,
- The management of the associate conditions,
- The therapy of arterial hypertension.

The therapy includes both a drug-based cure and non-drug based prescriptions. Majority of cases requires a combination of two or more drugs to maintain the values up to 140/90 mmHg. If the patient has in addition diabetes or renal failure, the target values are 130/80 mmHg and this can be reached frequently with three medicines at least. In Tab.II the algorithms of hypertension treatment for two different circumstances are presented comparatively [4].

The non-drug based prescription is given in terms of life style and diets including information about life style adjusting. These can be understood in terms of conducting rules related on the hygiene-dietetic regime of the patient as follows:

- to give up smoking,
- to reduce the exceeded of calories in food,
- to reduce alcohol consumption,
- to cut down salt in food,
- to avoid the chronic psychic stress as much possible,
- to practice some recommended physical exercises daily.

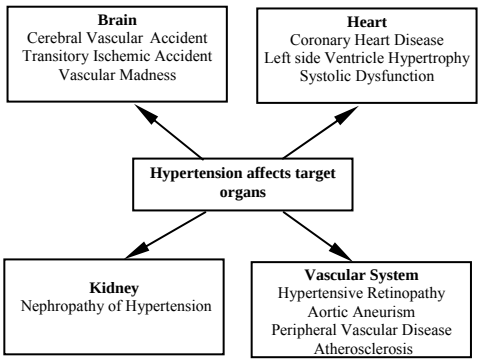


Figure 1. The effect of hypertension on target organs

Generally, all medication schemas are subject of dozes changing or introducing the additional drugs until the target level is reached.

Once the prescription schema was defined, it should be communicated to the patient in nonprofessional terms in association with a lot of particular information and details.

M. A scenario in current medical routine

Backing to above defined typical patient's profile we describe in the following an example from current medical routine of the family doctor related to these cases. This is an usual scenario for communication between doctor and patient that has to be structured, partly formalized and finally transposed into an algorithm in order to be implemented on a programmable multimedia homecare assistant (PMHcA).

The first step is to define the frames of information and their particularities. In Tab.III we propose a model of information framing and its describing in terms of the message, the communication and the content of the medical prescriptions in the current doctor practice.

TABLE II
MEDICATION-BASED ALGORITHMS IN HYPERTENSION

JNC-VII[1]	Hypertension cure for diabetics
If *BP>140/90 mmHg* ↓ Then *Tiazidic diuretics (tiazidic type)* ↓ If *BP>140/90 mmHg persists* ↓ Add *Inhibitors of Rennina-Angiotensina System* ↓ Add *Calcium antagonists*	If *Diabetes and BP>130/80 mmHg* ↓ Then *Initiate therapy with Enzime Inhibitors of Rennina-Angiotensina System or Antagonist Angiotensina II* ↓ If *BP>130/80 mmHg is maintaining* ↓ Then *Increase the doze* ↓

[1]Joint National Committee of Prevention Detection Evaluation and Treatment of High Blood Presure- 7th report.	If *BP>130/80 mmHg is maintaining* ↓ *Associate diuretics in small dozes* ↓ *Associate long term action Calcium Chanel Blockers* ↓ *Associate beta blockers and/or alfa blockers*
During the treatment the lipids profile must be strongly monitored. The cutting down of LDL-cholesterol by using of statins leads to 32% less CVA.	

TABLE III
MEDICAL PRESCRIPTION AND COMMUNICATIONS

No. crt.	The message	Way of communications	Multimedia content
1	Stating the case for doctor to the patient in order to become aware of his or her disorder.	Verbal	Audio streams, Text
2	Hygiene and dietetic measures. Conducting rules.	Verbal, Written notes, Printed brochures, Gestures	Audio streams Video streams Text
3	Establishing and explaining of the treatment schema.	Verbal and written	Typical on specific preprinted form
4	Next control schedule.	Verbal, written note	Audio streams Text

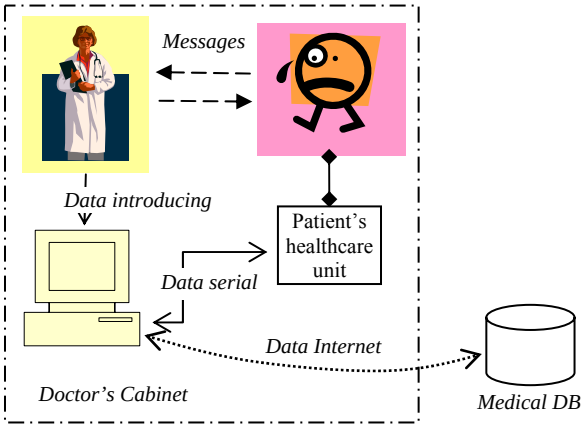
III. TECHNOLOGY

This project is based on the realistic hypothesis according with the availability of the equipment and communications support is credible all over the world. Under these circumstances the patient does not need to have/to use a PC or other audio video equipment, which in fact should run 24 hours a day in order to assist him or her. The idea was to develop a system based on an efficient, low cost, mobile, and versatile assistant unit to provide 24 hours a day the multimedia contents related on the proper medical prescriptions. In addition, the unit supports in a simple manner connection with and data acquisition from a large class of health monitoring devices. Now there are commercially available single unit devices that measure and transmit medical parameters: Blood Pressure, One Lead ECG, Heart rate, Heart rhythm regularity, SpO2, Body Temperature and Breathing rate. In a similar manner the assistant unit is capable to change data over the Internet accessing medical data basis or emergency services via radio, cable, or telephony networks.

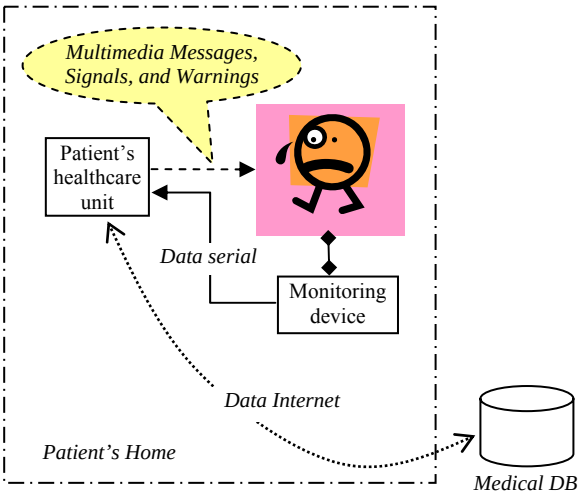
Under these circumstances a dedicated programmable architecture was proposed to perform the following functions at home: advertising/alerting of the patient on his daily-prescribed drugs administrating, advising of the patient about his specific hygiene-dietetics recommendation, vital parameters monitoring in order to adapt the treatment. In addition the assistant unit will be capable to play the short video clips on medical instructions and educational contents. In fact it has to process the multimedia content of medical information described in Tab.III. This design also supports a built-in extension for Internet connection for the loop closing into the telemonitoring service. The whole application is designed as a distributed architecture based on three platforms:

- The dedicated *multimedia homecare assistant* as an end-user mobile unit,
- The doctor's desktop work station or a mobile notebook/Personal Digital Assistant (PDA),
- The (local/regional) server of telemedicine services.

The actors in the system, protocols, and the main flow process in the proposed architecture are depicted in Fig. 2 a,b. This architecture supports different scenarios conditioned by the capability of the patient to go or not to go to the cabinet



for the consultation. In the latest case, based on the patient's



(a) The protocol in doctor's cabinet

(b) The protocol at patient's home

Figure 2. The medical information context and communications

records in the medical data basis (DB) the doctor can remotely prescribe or adjust the therapy. The patient receives the new prescription via data link into his or her homecare assistant unit. Other alternative is the common situation when the doctor makes a home visit to the patient. In this case the doctor has to program directly the patient's homecare assistant unit.

N. Hardware considerations

The PMHcA is an open architecture based on a core processor that manages a voice and acoustic signaling module, a display and visual signaling module, a data storage and programming module, a data input module for medical monitoring devices and an Internet based communication interface.

The hardware platform is entirely driven by the core processor that drives all the programmed functions. Basic architecture of the unit is depicted in Fig.3. Basically, this is the typical palms or PDAs architecture. In fact these devices have proved they are suitable candidates for our purpose. They are very flexible by programming, support multimedia communication, and can usually communicate data by several standards including wireless, infrared and Bluetooth. Latest

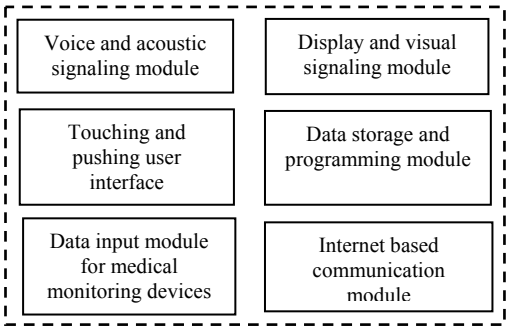


Figure 3. Basic structure of the multimedia homecare assistant

versions include a built-in camera and GPS/GPRS integrated. More over, they are small, portable, and friendly user. As a mater of fact, the usability of these pockets can be extended successfully in the area of healthcare applications with costs that are expected to go down from the technological point of view. Handheld computers are becoming an important tool and have grown in popularity in the medical community in the past 5 years. These devices have evolved from simple data organizers and calculators to sophisticated reference and decision support tools.

O. Software platform

The application software has a special importance in this project. Here we refer to a software platform because the programmable multimedia homecare assistant is integrated into the large distributed e-Health system. Three main components define the software platform that supports working with a PMHcA, as follows:

1. The operating system (OS) for mobile pocket PCs supporting the proper application software for PMHcA;
2. The OS on the doctor's computer supporting the main medical application software;
3. The server OS that manages the clients remote access to the medical DB and to the complementary services.

In the area of dedicated software for pocket PCs there are recently reported diverse applications for medical field. The main parts of them are powerful and integrated source of clinical information including veritable monograph of diseases, case studies, drug references, and related issues. Medical calculators, handheld computer programs, can be used for supporting clinical decisions. Other programs provide evidence-based reviews, relative costs of different treatments for common illnesses, and various medical decision-rule calculators.

All in all the basic functions of PDAs can be quite valuable in medical practice. Reference [6] provides an overview on the issue of handheld computing in medicine. Recent literature [1], [2], [3], [5] and [7] also reports about different handheld computer based medical applications and their impact into the medical community as well as on patients.

Going on the idea to implement the PMHcA on the commercial PDAs our project goes to fill a gap on their large scale using for healthcare applications. In our opinion, the PMHcA must be more than a portal to medical knowledge source or than a high connective device, but an excellent extension of the family doctor at the patient, 24 hours a day, wherever he or she would be. This function is accomplished by a particular software application named *assistant program* dealing with the current information about patient's state. Two basic information circuits are provided by including the PMHcA on one hand into a local loop of a monitoring device and into a large loop of a health care enterprise, on the other hand. The assistant program manages the particular information described in Tab.III and runs the functions of the specific modules presented in Fig.3. In fact, the doctor's expertise is delivered to the patient according to the medical practice routine as they would be face to face. A main feature of the program is the capability to adapt the therapy by the alternative prescriptions. In fact, it plays the role of an interface for doctor's telepresence.

A basic flowchart for the assistant program built on the algorithm described in Tab.II is depicted in Fig.4.

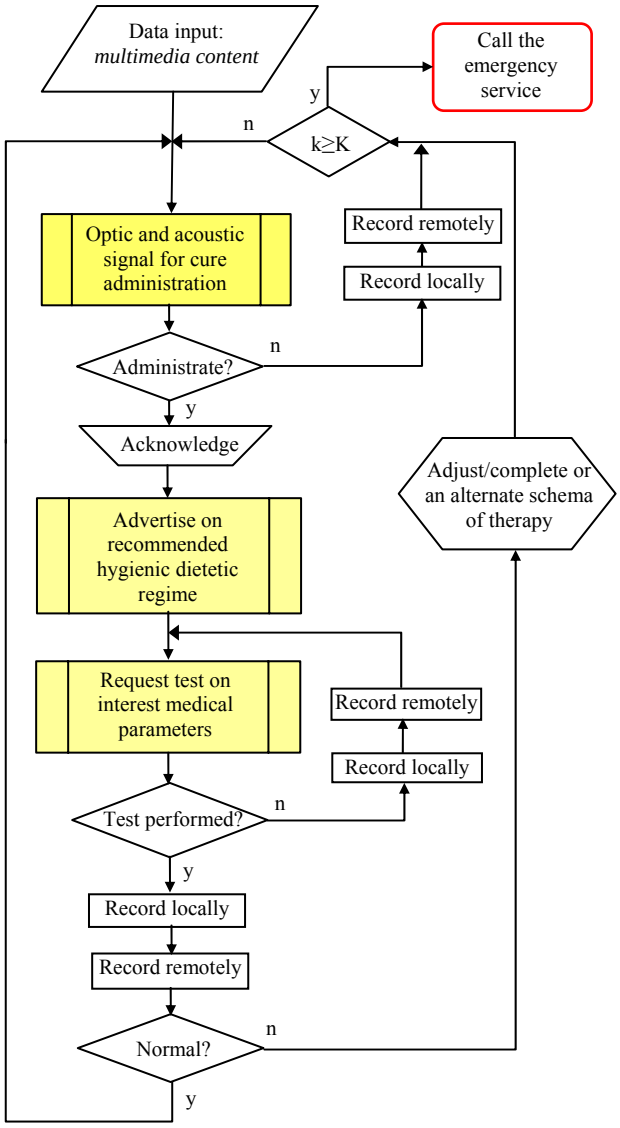


Figure 4. A flowchart for assistant program

IV. Conclusions

The proposed programmable multimedia homecare assistant (PMHcA) is an excellent platform that integrates many functions to provide more effectiveness into the telemedicine systems. At first glance, it may seem the PMHcA only replaces different stand-alone applications like a wireless real-time pill bottle signaling and connectivity by a mobile phone, etc. into a single unit. In fact, this is only a secondary aspect, because the PMHcA concept is based on the idea of programmability and high connectivity in order to provide the doctor's telepresence 24 hours a day, wherever the patient would be.

First, this application is a step towards electronic transfer of medical prescriptions, in fact a multimedia extension of e-prescribing as well as an efficient instrument for patient tracking. Second, this is a low cost efficient solution for a multipurpose patient terminal that is capable to support many homecare services including telemedicine applications. Third, thanks to the multimedia processing capability the proposed system is very efficient to maintain the doctor and chronic patient closely between the regular consultations. This facility is also valuable for isolated communities, military, etc. All in all in terms of benefit in medical current routine we expect a high efficiency for the family doctors with more than 1,500 of patients from which the chronic are over 50%. Technically speaking we think the unit is a useful terminal for e-Health and homecare applications addressed especially to the older patients.

In this stage this unit is considered to be a flexible interface between doctor and patient, a mean to increase the doctor's assistance by his virtual presence that provides the medical recommendations and can repeat untiringly any required information. The next step is going on the Intelligent Personal Health Assistant supposing the extension with an advanced medical expert system and also with a high capability to access the large medical knowledge basis.

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Automatic Fall Detection and Activity Monitoring for Elderly

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Abstract- Our modern societies are suffering the increase of elderly population while at the same time social security and health costs must be cut down. In order to avoid the need of special care centers, the actual trend is to encourage elderly to stay living autonomously in their own homes as long as possible. The product presented in this paper contributes to this objective, since it provides user localization, automatic fall detection and activity monitoring both for indoors and outdoors activities, associated to a complete call centre for medical monitoring of the patient as well as to provide support and manage emergency situations.

I. INTRODUCTION

In most of our countries, elderly people represent the fastest growing segment of the population, and this trend will increase over the next years. Indeed, by the year 2035, one third of the European population will be more than 65 years old. At the same time, the Public Health Services institutions have to face budget restrictions and increasing pressure to limit costs. Together with the lack of rooms in the care centers, these evolutions lead to encourage elderly to stay living longer at home instead of being admitted in care centers. For the elderly population, which represents a large part of Social Health Services expenditures, it means most of the time living alone and independently in their homes, with all the risks it involves. Tackling these expected needs, investigation has led to the development of a wide range of telemedicine systems over the last 20 years [1]. Such systems are designed to offer major security to persons living alone in their homes, including to persons admitted in care centers, as efficient tool to assist carers in their tasks.

One of the major risks incurred by the fragile population (elderly, illness, people in adaptation time after a chirurgical intervention, etc…) is to fall. Indeed, 30% of elderly people fall once a year at least, representing 75% of the victims of falls. The fall event is responsible for 70% of accidental deaths in persons aged 75+, and for increasing the level of fear, anxiety or depression leading to the reduction of the day to day activity. These observations have encouraged the development of fall detection devices to detect or even prevent a fall event and to ensure a rapid and efficient help when such an event occurs [2]. But very few fall detection systems are yet commercially available today, due to lack of reliability, lack of easiness to install and use, or because people did not accept a system found too intrusive or expensive for instance.

After an overview of the actual systems available, this paper describes an innovative product developed to offer new services to elderly. A mobile and totally autonomous module, associated to a highly advanced call centre, offers full activity monitoring, automatic fall detection and user localization to the elderly both for indoors and outdoors activities with one unique system. The functionality of the system (both regarding to services and technologies implemented) as well as its use are explained in the following paragraphs. Fig. 1 shows an overview of the services implemented on the automatic fall detection and activity monitoring system presented in this paper.

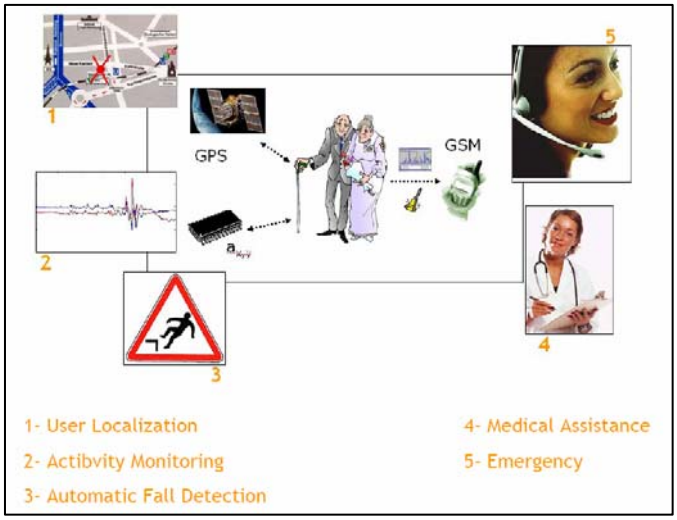

Fig. 1: services offered by the system

II. BACKGROUND

Telemedicine systems include all the systems designed to help high risk population (due to old age, illness such as epilepsy or Alzheimer, recent chirurgical intervention) to improve their quality of life, by reducing the risk factor and the stress, by giving them more freedom in their movements and activities they can perform, and by reducing the stress level of their carers (relatives or professional carers). Such systems are designed either for people living alone in their home as for people living in a care centre.

Different telemedicine systems have been developed, with different complexity levels, from a simple device to remember the person when to take her/his medicine, to a completely instrumented house with complex multi-users interface and artificial intelligence to adequate decision-making tasks [1] [3]. The most common systems in Europe are certainly the so-called social alarms, which consist on an alarm button worn by the user. The user raises an alarm by pushing the button, and a care centre is alerted through an automated phone call made by a central connected to the user's telephone. Such system is of course limited: if the person has no possibility to push the alarm button (unconsciousness, broken arm, etc…), no alarm is sent. Furthermore, its use is limited to indoor use.

Since falls is the major concern for elderly and their carers, logically most of these telemedicine devices are dedicated to the fall detection. The fall detection requires a device with special features due to the large number of parameters involved and to avoid the system to be uncomfortable or perceived as too intrusive [4]. Different technologies have been investigated to detect a fall, which can be divided in four main groups [5]:

Worn device, immediate detection:

This category includes small devices worn by the user able to detect the fall event when it occurs and to raise an immediate alarm. The technologies used are impact, position and tilt sensors, and accelerometers together with adequate control algorithms performed in a micro controller. Fig. 2 shows examples of fall detectors.

Worn device, unusual behavior:

These fall detectors are also small devices worn by the user, but they are not able to detect a fall event. They rather monitor the activity of the person, and detect an unusual behavior comparing to a typical behavior pattern of the person. Such systems may last some time before raising an alert (an unusual behavior can only be detected on a time increment of 1 hour or more), and do not differentiate a fall from another abnormal behavior.

Environment sensing, immediate detection:

Such technology consists in the installation of sensors in the environment of the person to detect a fall event. Technologies used are for example video recording and image analysis, sound analysis, installation of shock sensors on the ground or in the carpets, etc… The main disadvantages of these systems are that they require installation of sensors in each room of the house (including wiring), that they are too intrusive and that they might be expensive (video analysis).

Environment sensing, unusual behavior:

Like in the previous category, the environment is equipped with sensors to be able to monitor the activity of the person. For instance, contact sensors or Infra Red (IR) barriers are placed on the doors and windows, passive IR detectors are installed in the rooms. The information collected by the sensors is then analyzed thanks to intelligent analysis systems (artificial intelligence) to detect an unusual behavior, and so the eventuality of a fall. Such systems require heavy infrastructure (lot of sensors and complicated wiring) and good analysis system. They often result to be quite expensive.

This rapid state-of-the-art makes evident that no system actually completely meets the user's requirements. Worn devices with immediate detection seem to be the most adequate solution to fall detection in the elderly. Nevertheless, very few commercial systems are actually available on the market. The main difficulties are to design a reliable detector, no cumbersome and easy to use. Through the new product presented, Fatronik pretends to present an innovative system with improved performances and functionalities, including activity monitoring and fall detection functionalities, both for indoor and outdoor use. Product's main functionalities are presented hereafter.

Fig. 2: example of fall detectors

III. USERS REQUIREMENTS

The first step in the design of the product has been to clearly identify the user's requirements and the lack in the existing products to meet these requirements. Focus groups with final users have been organized to discuss the functionalities that the fall detector should include as well as other aspects final users consider important to be taken into account (i.e. user interface, services, ease of use, esthetics, etc…). Special efforts have been made to have a product user-oriented. Indeed, elderly are quite exigent users, and the system has to be specifically designed to meet their needs to be used. The most important user's requirements to be taken into account, in order of importance, where given for:

Reliability of the system:

Wearing such a system is an additional complication to elderly people, and is worth only if the system is reliable in detecting falls and abnormal situations. One of the main aims of the product is to give more confidence to users in their daily life, and such objective will be achieved only with a highly reliable system. Final users do not want false detections neither they want falls not detected.

Functionalities and services to be implemented:

A wide offer of services can be implemented in such a platform. However, according to final users, three services are like the most important for them to be implemented. Activity monitoring is useful in order to have a medical monitoring of the person. Automatic fall detection, without the need to push a button to raise the alarm, is considered as an important added value comparing to existing systems. Finally, user localization has two main interests: localization of the user when a fall is detected to send emergency services to the right spot, and help to a lost user to find his way back home from the call centre. The possibility to use the detector both inside and outside is considered as a real advantage.

Design for non intrusive and discrete system to be worn:

To wear a fall detector is perceived as an intrusive and quite disturbing step to take from elderly: they lost their autonomy and admit the need of such a service is hard. To make it easier, special effort has to be made to make the fall detector discrete to wear and non intrusive in the daily life of the elderly. The ideal would be other people not being able that someone is wearing the fall detector.

User interface and ease of use:

Elderly people are not used to new technologies and electronic devices, and their acquisition process is always more difficult that in young people. The interface of the detector must be simple, intuitive and easy to use. The information displayed must be clear. Taking into account possible little disabilities of elderly, both visual and auditory signals should be used. Finally, a "Reset button" will be implemented on the interface: it will allow disabling an alarm automatically set, and well as voluntarily setting an alarm by the user if necessary.

Respect of privacy and personal data:

Some of the data managed by the detector and the call centre is considered as critical and should be protected to ensure privacy aspects. Indeed, information such as user localization or activity of daily living is considered as personal enough as to be treated with the necessary considerations to respect user privacy. Some mechanisms will be implemented to respect user's privacy.

Most of the requirements detected from the final users where expectable. These discussion groups permitted validating the need to develop a new system with new features, as well as the main functions to be implemented. Requirements are really demanding regarding to final size or weight of the system, however technological limitations will have to be taken into account. The functions implemented are user localization, activity monitoring and automatic fall detection. GPS, GSM and GPRS technologies will be implemented to allow indoor as well as outdoor use. Finally, special effort will be made to take into account user requirements regarding to interface, use and privacy. The project will be developed in close collaboration with elderly and gerontology centre.

IV. DESCRIPTION OF THE SYSTEM

This section will describe the system developed, as well as its main functions. The system includes the following main elements:

- √ A mobile module worn by the user, performing the user localization, automatic fall detection and activity monitoring;
- √ A call centre for data reception from the mobile module, data analysis and saving, and for managing emergency situations.

MOBILE MODULE

√ ***Functionalities:***

The mobile module is worn by the user at any time. It is the analysis centre of the user's motion used to perform activity monitoring and automatic fall detection.

Ergonomic aspects and interface:

The mobile module will be worn at the belt, since this place has been defined like the most discrete and convenient taking into account the size and weight of the module. Its interface will include a "reset button" easily accessible to cancel an alarm if necessary (case of false alarms, or of falls without consequences for the person) or to set voluntarily an alarm (need of assistance even if a fall didn't occur). The user's interface is completed by luminous and auditory signals regarding to the state of the mobile module: battery charge, fall detected, validation of alarm sent, etc… This interface is simple and reduced to the strict minimum.

Activity Monitoring:

Kinematical activity of the user is continuously real time analyzed while the user performs any activity in its daily life.

The activity monitoring classifies the user activity according to three levels: low, medium and high level activity. This monitoring is performed once a minute and data is recorded on the module. Once a day, the activity of the last 24 hours is sent to the call centre for analysis. This function allows carers to monitor user activity and detect abnormal activity.

Automatic Fall detection:

The automatic fall detection is also continuously real time performed while the user performs any activity in its daily life. Implemented algorithm detects when a fall occurs. Based on fall patterns, the system is able to differentiate day to day activity from falls of any kind, and so to avoid false alarms (activities that have been detected as a fall and that are not a fall). Day to day activities are numerous and varied on the one hand, and any kind of fall has to be detected (reliability) on the other hand, which leads to possible hypersensitivity of the system (numerous fall alarms). The fall detection algorithm implemented takes into account these difficulties to perform reliable automatic fall detection. Furthermore, in an extreme case that a fall alarm occurs, or a fall has not been detected, the "reset button" can be used.

User localization:

User localization service is integrated on the system. The use of GPS technology allows total outdoor localization at any place, giving more flexibility in the use of the system. This function is necessary to complete two main aspects: precise localization of the user in case an alarm is sent (due to an automatic detection of a fall or to an alarm set by the user on the "reset button") to send emergency services to the right spot and increase rapidness in the response, and to help user to find its way back home in case it get lost (some elderly people do have problems of memory and orientation, and get easily lost). From the call centre, instructions will be given to the client to route him safely back home.

Bidirectional voice communication:

The system also includes a bidirectional voice communication between the patient and the call centre, as a kind of cell phone. The system is not a cell phone, and this functionality is activated from the call centre only. However, it is useful in case an alarm is received, to be able to talk to the user and assess the gravity of the event as well as the type of emergency or help needed at this moment.

√ ***Technology:***

High level technologies have been implemented within the system to perform the required functions as well as to allow indoor and outdoor use. Miniaturization and low power consumption have been specifically taken into account from the beginning considering that the system is wearable and is chargeable batteries powered.

Kinematical activity:

Both activity monitoring and fall detection algorithms require the kinematical activity of the user to be continuously monitored on real time. A biaxial accelerometer is used to detect the different movements of the user during its activities of daily living. Fig. 3 shows the typical outputs from an accelerometer during different type of activities. To reduce to the maximum the system's final size, specific MEMS (Micro-Electro- Mechanical Systems) technology has been chosen to be implemented.

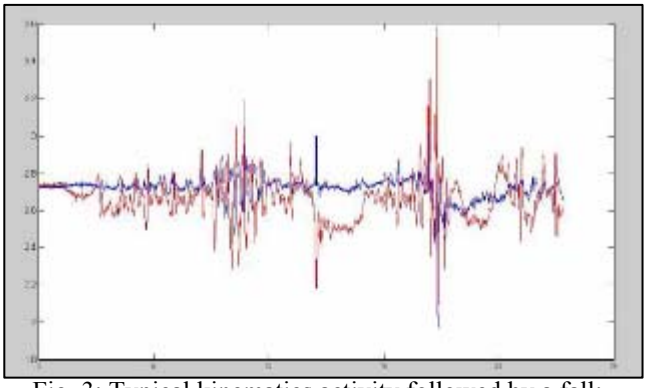

Fig. 3: Typical kinematics activity followed by a fall: biaxial accelerometer output

Activity monitoring is performed through a neural network which, by analyzing the inputs from the biaxial accelerometer, is able to classify the user's activity in three main categories: low, medium and high level activity. Each minute, the level of activity is assessed and saved. The activity monitoring report is sent to the call centre once a day (24 hours recordings).

The fall detection algorithm is mainly based on the comparison of the instantaneous inputs from the accelerometers to defined activity patterns and parameters to differentiate between a fall and a normal activity. This algorithm is designed to reliably detect most of the falls (frontward, backward, lateral, lost of consciousness) and to differentiate it from other normal activities (sit down, go upstairs or downstairs, run, etc…).

User localization:

GPS technology is used to localize the user. The main advantage of GPS is that user can be localized wherever he is around the world, except within the buildings. In order to optimize power consumption, GPS coordinates acquisition is configured to be dependent on the movement speed of the user: if the user is moving rapidly (within a bus or a car for instance), GPS coordinates will be acquired more frequently than when the user moves slowly. Furthermore, the last acquired GPS coordinates is saved within the system to be used in case GPS reception is lost, or in case the user is within a building (the last saved GPS coordinate will indicate the entrance door of this building, making possible user's localization). GPS receiver and its antenna are integrated within the mobile module.

Communications:

The mobile module will be used both indoors and outdoors, and will require permanent communication with the call centre. The use of wireless technologies widely available worldwide is required. GSM/GPRS emission / reception module and its antenna have been implemented within the mobile module. This network is used both to send and /or receive data from the call centre (alarm, activity monitoring report, localization) and for the bidirectional voice communication. Reception and emission is managed through UDP socket protocol. GSM/GPRS technology is widely

available at a low cost, including inside the buildings. It makes possible to use the system both for indoor and outdoor activities without any problem.

When an alarm is detected, ensure good communication is critical. A specific communication protocol, including the necessary acknowledgements, has been implemented to ensure that the alarm has been successfully received by the call centre. The user has confirmation that the call centre received the alarm. If no alarm can be sent (due to loss of GPRS network), the user is also noticed to give him the chance to find another way to get help.

√ ***Use of the system***

The mobile module has to be worn by the user at any time to be effective. Fig. 4 shows the first prototype that has been implemented. The final system, waterproof, will be fixed to the user's belt. The user has nothing more to do than to turn its system on and to clamp it to its belt.

If no abnormal situation is detected, the system will periodically save the user's localization and activity level. Once a day, an activity report is sent to the call centre, without requiring any action from the user.

If abnormal situation is detected (fall detected, user pushing the "reset button" or any other abnormal situation, the system sends an alarm to the call centre with the necessary information (type of alarm, user localization, date and time of the alarm…). A confirmation to the user is given when the alarm is going to be sent (the users has 20 seconds to cancel the alarm before it is sent), and when the alarm has effectively been sent and received by the call centre. Call centre operator can, if necessary, get into contact with the user to get further details on the situation. Finally, adequate help is sent from the call centre.

The mobile module is battery powered. A battery charge indicator will tell the user when to change the system's battery and put the empty one to be charged.

CALL CENTRE

√ ***Functionalities***

A call centre is an organizational unit which is responsible for collecting and handling incoming calls. The call centre centralizes all information from the different patients equipped with a mobile module. Its mains functions are to receive the data from these modules, analyze and save it in databases, as well as to detect and manage emergency situations.

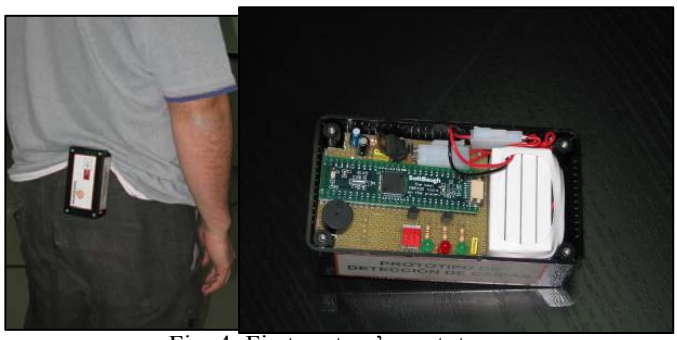

Fig. 4: First system's prototype

Receive and classify information:

One call centre can manage several mobile modules (several users can use the same service). The information received from the mobile module is of different kind: activity monitoring report, once a day, and alarm message, when an abnormal activity is detected.

Activity monitoring report is received once a day from each mobile module. It includes as a minimum the mobile module ID, time and date of the report, as well as the activity level for each minute of the last 24 hours (activity level is monitored each minute). This information is automatically received, analyzed, classified and saved in the corresponding databases. If abnormal activity is detected comparing to predetermined patterns, an alarm message pops up on the call centre.

Alarm messages are received whenever a fall is detected or the user voluntarily set an alarm on the mobile module. The reception protocol of this kind of message follows specific characteristics with the required acknowledgments to ensure that the critical information is received. Such a message includes as a minimum mobile module ID, type of alarm (fall, set by user, etc…), date and time, user localization. When such a message is received, it is automatically analyzed and emergency message pops up on the call centre interface depending on the kind of alarm. Furthermore, instructions on how the carer should actuate to respond to this emergency is displayed.

Retreive information:

Apart from the information automatically received by the call centre from the mobile module, specific information can be retrieved by the call centre, such as activity report and localization data. At a given time, the carer has the possibility to retrieve given information from a specific mobile module. Indeed, if abnormal activity is suspected, an anticipated activity monitoring report can be retrieved from the call centre, without waiting for the mobile module to automatically send it. Regarding to user localization, real time localization information can been retrieved from the call centre from a given mobile module, functionality very useful in case the user get lost and asks for help. The localization data retrieved is the last valid data acquired by the system.

Localization:

User localization data is given from the mobile module through GPS coordinates. The call centre integrates maps to automatically transform these coordinates into useful information such as the city and the street that corresponds to this GPS data.

Reports:

The information received from the mobile modules is saved within a data base. In order to facilitate medical monitoring of the users and to exploit better the available information, reporting generation functions have been implemented on the call centre. Oriented to the carers and medical staff, they aim to automatically retrieve the pertinent information from the database according to search parameters and to present it on a report. This function allows studying historical data from given users to monitor their evolution over the time.

√ ***Technology***

On a technological basis, the call centre is mainly made by two elements: the reception software and the call centre itself.

Reception software:

Specific software has been developed to manage the communication with the mobile modules and receive and/or retrieve the data. The application is developed under Visual Basic and is integrated to the call centre, installed on a PC. Through the serial port, a modem is activated to manage the communication protocol on UDP socket. Reception software has different routines implemented, depending on the kind of information retrieved (for critical information, additional security and acknowledgement are implemented). For the user, this reception software is totally transparent in its use.

Call centre:

The call centre has been developed as a web-delivered application to reduce cost of ownership and increase ease of deployment and maintenance regarding to desktop delivered application. Furthermore, Microsoft.net platform has been preferred towards Java application for the development for a better scalability and lower cost of development. Regarding to the databases implemented, SQL Server technology offers all the required functionalities for this application. The call centre is built according to the following architecture: Operating system is Windows, Database developed under SQL Server, development tool is Microsoft.NET platform, and user interface is web browser based.

Furthermore, security issues have been covered on the application, by defining different access privileges levels depending on the information accessible in each area of the system.

√ ***Use of the System***

The use of the reception software is totally transparent to the user and carer. The call centre is based on forms, accessible to users according to their privileges by login on the system. Each category of users will have access to a determinate security level, and so to determinate functions on the system.

Once logged on (the call centre is web based and so accessible form any browser worldwide), the user accesses to different forms in which information can be filled, retrieved or parameterized. The main forms available on the system are:

- Patients: information related to the different patients equipped with a mobile module (Fig. 5),
- Devices: information related to the mobile modules available,
- Events: information related to the events received by the call centre from the mobile modules,
- Reports: reporting functions according to filters to retrieve information from the database,
- Parameters: to parameterize the call centre.

The call centre has been designed for non initiated users since carers and medical staff is not necessarily used to this type of application. Its use is intuitive, simple, and the different forms limited to the necessary features. Advanced functions have been implemented in order to automate the use of the system.

V. CONCLUSION

Growing demand on services oriented to elderly makes justified the development of improved system to help elderly live longer in their home increasing their quality of life. The product presented here represents an important step beyond the actual state of the art in services to elderly. Indeed, the service offers complete activity monitoring, automatic fall detection and user localization on a small autonomous mobile module both for indoor and outdoor use. The system, composed by a mobile module worn by the user and a call centre to analyze and save the information, has been developed as easy to use and reliable, and final user requirements have been taken into account on any stage of the development.

The first tests and validations, both realized in laboratory conditions as well as with final users (elderly in gerontology centre) show that the system meets well the requirements, is reliable (above 90 % of fall detection) and well accepted by final users.

This work has been sponsored by the European Community under the CRAFT project HEBE contract number 5935 in collaboration with partners from Spain, France and Greece.

Fig. 5: Example of the patient's form in the call centre

Acknowledgment: this work has been sponsored by the European Community through the CRAFT project Hebe contract nº 5935

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Home Based Integrated Care in Patients with Chronic Respiratory Failure with the Use of e-Health Services

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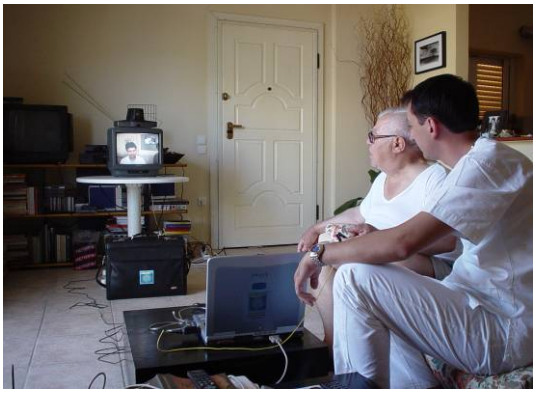
INTRODUCTION

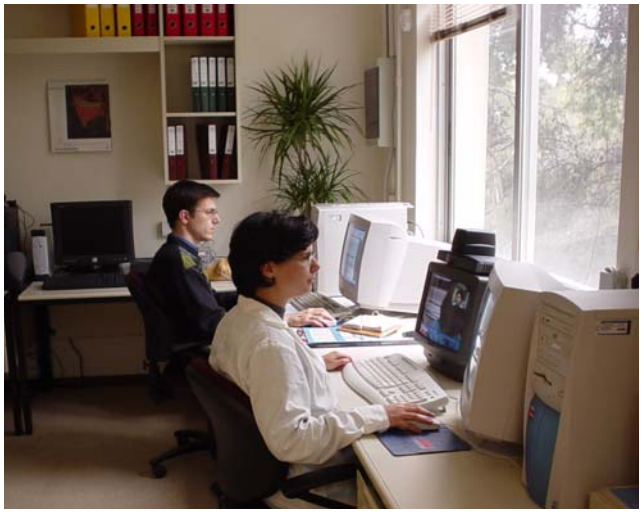
COPD (chronic obstructive pulmonary disease) is a chronic progressive lung disease, characterized by frequent exacerbations, resulting in patients' poor quality of life and repeated hospital admissions. The aim of the study was the evaluation of clinical usefulness of an advanced e-health system in home-based rehabilitation and follow up and home hospitalization of patients with advanced stages of COPD.

METHODOLOGY

Eighteen subjects (mean FEV1 0.73 L) with at least four admissions for COPD exacerbations in the previous 2 years, including admissions in Intensive Care Unit, were followed up for 12 months, after an initial outpatient evaluation and rehabilitation phase.

The telemedicine system we employed, consisted of a specially designed electronic health record (EHR), a compilation of integrated medical peripherals (spirometer, oximeter, ECG ect.), for patients' monitoring and a digital camera for real time video communication (by using one ISDN line of 128kbps). Through the system, a large variety of preventive and therapeutic tasks became possible for the members of the rehabilitation team from hospital to patients' homes. These tele-visits were performed at a frequency of about once a month, either on a regular or an emergency basis.

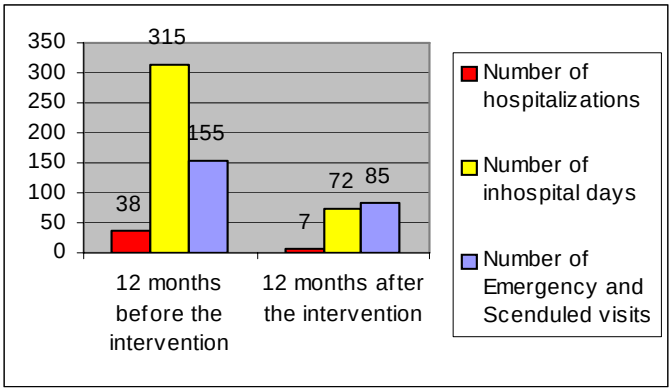




RESULTS

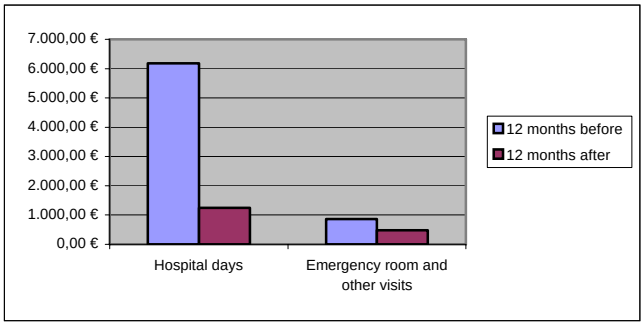
During the first year of the program, the number of hospital days fell to 4 from 17.5 per patient, within the year before the intervention.The hospital admissions declined to 0.4 from 2.1 for the same time period. The emergency and scheduled hospital visits fell to 4.7 from 8.6 and accordingly the cost savings from the reduction of both, hospital admissions and

Use of Hospital services



visits were 1721€ from 7042€ for the previously mentioned time periods.

Cost savings



The patients also gained a significant amount of disease knowledge and self-management abilities, as they were measured throughout the follow up period. As a result, they had a significant and sustainable improvement in their quality-of-life (22%, using CRQ scale), exercise tolerance and psychosocial status scores.

DISCUSSION

The positive outcomes are probably reflecting the combined effects of the comprehensive intervention, regarding the prevention, early detection and the treatment of the disease exacerbations. They are compatible with recently published studies performed in UK and Spain, though they were mainly focused on the acute treatment dimension. The intervention's design was based on the so called "chronic care model", adopted recently by WHO, which requires information sharing, coordination and optimisation of multiple factors involved in chronic patients' care. All these tasks were greatly facilitated by the e- health system in a cost effective manner.

CONCLUSIONS

It seems that the adoption of e-health services in everyday clinical practice can substantially support the application of optimal services for chronic patients' care. The selection of proper technology combined each time with the treatment protocol of the patients' categories and stages, is of critical importance. The explosive evolution of e-health technologies followed by continuous cost reductions are strongly encouraging this adoption.

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Luxembourg Heart Failure Project, A new concept of Homemonitoring for Patients with Congestive heart failure

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Epidemiological background and public health relevance: Congestive heart failure (CHF) has become a health problem of epidemic proportion. Due to results of SHAPE (Study on Heart failure Awareness and Perception in Europe) 3.6 million new heart failure cases are reported each year in Europe. About 14 million people in Europe are affected today and this number will probably increase to 30 million by the year 2020. CHF related hospitalisations have more than doubled in the last 20 years. Heart failure patients experience a lower quality of life than patients suffering from any other chronic disease. [1] In France the costs of treating heart failure are estimated between 109-208 M€ every year. [4]. The German heart foundation reports, that Germany spends approximately 286 M€ per year on the treatment of about 1.5 million heart failure patients.

IT supported managed care: Better methods of secondary prevention are urgently needed to reduce life threatening situations and health care costs. In most cases a conventional pharmaceutical therapy has only modest effects on morbidity, mortality and quality of life [2]. Because of the limited number of donor hearts, cardiac transplantations are limited to younger patients. Recent studies have shown that re-admission, length of stay and hospital charges are significantly decreased when tele-homemonitoring is embedded in well adapted managed care programs [3]. It is assumed that reduced re-admission rates will also have a positive effect on the quality of life.

The Luxembourg Heart Failure Project (LuHF) has developed an integrated home monitoring solution, based on a patented data analyse method to estimate the patients health status at distance. To minimize risks for the patients, the health estimation will be based on a set of physiological parameters. One important requirement is, that elderly and disabled patients may use this system easily, without the help of a health professional.

Methods: The LuHF team has developed a tailor-made Monitoring Instrument for Cardiology (MonICard), able to record a one-minute Electrocardiogram (ECG) synchronic to the patient's oxygen saturation (SPO2), supplemented by non-invasive blood pressure (NIBP) and weight. A secure data transmission to the patented MonICard Analyse Unit will be followed by a remote estimation of the patient's health status, based on computed health indicators (e.g. Pulse Transit Time (PTT)). First results with a limited number of in-patients have shown that this method allows it to react on early health fluctuations The system will be tested with CHF-patients (NYHA Class III-IV) in Luxembourg and two university hospitals in Germany and France. Events such as death, readmissions and hospitals days will be recorded. A health economic evaluation will estimate effects on quality of life and health care costs.

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Keywords: Tele-home monitoring, Managed care, Congestive heart failure, MoniCard

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Telecare – Practical Experiences with Video Communication in Homecare

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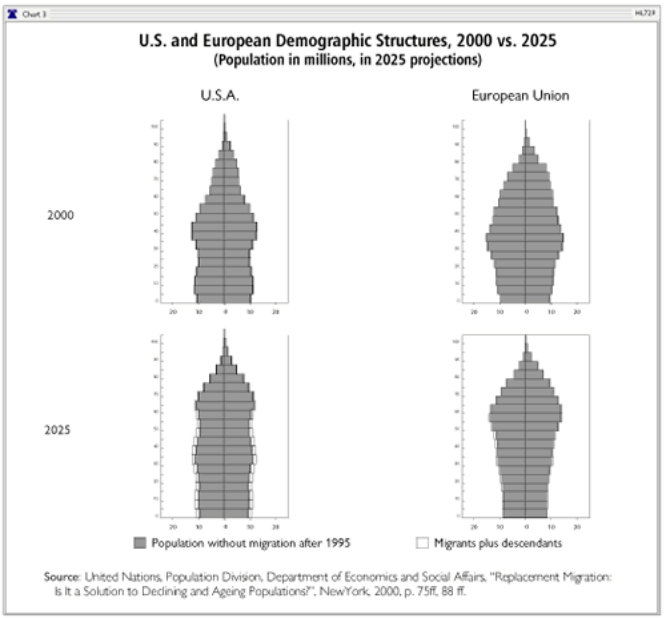
***Abstract*-It is said that Video Communication in homecare can notably improve the quality of life, for both the elderly and their relatives, by increasing the independence, confidence and security of the elder person while reducing the cost of home care. Unfortunately the number of pilot projects and studies highlighting the usability of video in home-care in Europe is limited. By referring to relevant literature, this paper describes the experiences gained in two projects in Austria and the Netherlands, the proposed solution and an overview of future applications.**

I. INTRODUCTION

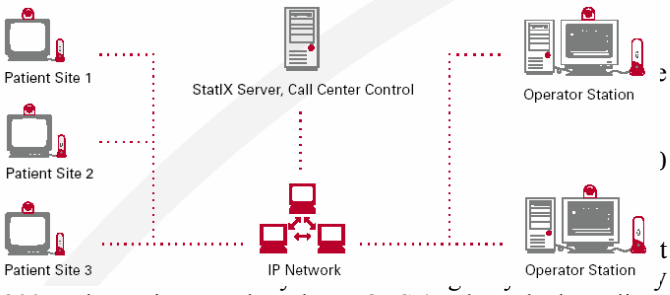
Ageing societies face the challenge of maintaining a high level of care and fulfilling the requirements of a steadily growing clientele, as well as controlling the costs of care delivery. The number of Europeans aged 60 years and over has risen by about 50% over the last 30 years [3,4]. This trend is continuing.

Innovative approaches to care delivery must be found in order to confront this challenge. These approaches must



enable care providers to maintain a high level of care, while also improving their services. This becomes particularly difficult in rural areas. The cost of social services are very high as a result of increased travel costs, unproductive time, and issues relating to staffing [2]. An important issue for elderly people is to stay at home as long as possible. This, however, requires an active lifestyle in order to address problems such as loneliness, interconnection with family members, and interconnection to dedicated service providers. 16% of the elderly express dissatisfaction with their social lives and according to family members, 28% of the elderly have little or no social contact [4]. Video communication as an additive to home visits can increase the efficiency and quality of home care as well as enabling closer contact with relatives and friends. Aguilar et al. recommends tele-assistance to include not only the specialized centers but also family members because this increases the confidence, health, and quality of life of the elderly [1].

Two European projects focusing on video communication in elderly home care have helped to clarify conditions for a successful implementation of the required technology. Both companies belong to the largest care providers in their country and have always played a major role in introducing



2005. The project was based on POTS (analog telephone lines with only 33.6kbps). In Q2 2006 Volkshilfe will enter the

next phase of the project using specially designed equipment on broadband IP networks (up to 384kbps). Telekom Austria, the largest telecom provider in Austria, will provide assistance with the project. In 2003, the Dutch care provider Sensire, began to implement video communication over ISDN (128kbps). In 2006, Sensire's video network will include 700 installations mainly via broadband IP networks (up to 384kbps). The network services are provided by KPN, the largest telecom provider in the Netherlands.

II. TARGETS

Relying on the experiences of various other research projects, which demonstrated the potential for technological solutions to increase the efficiency of care services, both projects were initiated in order to determine the conditions for a successful implementation of video communication in home care. The key questions to be addressed were:

- Could video communication really improve the lives of elderly people in terms of more security, more social contacts, and better access to care service?
- What requirements would the system have to fulfill with regards to usability and user friendliness?
- What additional training would the nurses require in order to use the system most effectively?
- What type of services could be offered via this technology?

III. FINDINGS

Both projects had a somewhat different focus. The Sensire project focused on usage issues of the system, wheras the Volkshilfe project focused on usability issues. Sensire, with its focus on how the system is used by the client, reported a higher ability of the clients to manage their life independently, lower consumption of medication, and less nurse intervention. Volkshilfe, with its focus on the usability of the system, highlighted the importance of a good relationship between the client and the caregiver in order to overcome initial doubts regarding technology. Another important issue for Volkshilfe was the ease of handling the installed equipment by the client.

- 50% of the questions asked via video were specific questions about medical issues that could only be answered by a nurse.
- 45% of the questions were because the elder person felt alone, inconvenienced, or unsafe.
- The average duration of a call was 7 minutes.
- Calls were received during the day and night.
- Call center operators observed a higher level of accuracy and improved assessment of circumstances that lead to higher efficiency during the caregiver's on-site visit.
- Call-Center agents need to share their experience with colleagues and need to receive specialized training.
- A lack of technical knowledge appears to be a problem for the elderly, but after a short time clients are familiarized with the system and use it accordingly.
- Clients do not feel intruded upon. Instead they encourage the caregiver to call them to see how they are and to check their current condition.
- Ease of handling, good picture and audio quality, suitable design for the elderly (font size, symbols, readability…), compactness, and support are basic requirements for such a system.
- Clients prefer more frequent video visits compared to less frequent face-to-face visits.
- Nurses say that video could replace some home visits and is useful as an additional service.
- The video call center also offers job opportunities for nurses who become unable to carry out their on-site duties.

IV. TECHNICAL

What has been observed from these projects is that the technical suitability is of major importance to the successful introduction of such services. SCOTTY Group, a company active in the field of telecare for almost 10 years, has developed a solution that perfectly suits the requirements of this particular environment. The solution is called CareStation.Net and is based on the so-called StatIX server that handles the initialization of calls and allows connection to 3rd party relational databases (SQL, Oracle). Additional features such as SCOTTY's Packet Buddy protocol allows simple communication by using only a single firewall port (instead of the 4 or 5 ports used by regular video conferencing protocols). Additionally, Packet Buddy includes data encryption, which is needed for the secure transport of medical data via the Internet.

The CareStation140 (CS140), which is the hardware in the home of the clients, includes a microphone with a built-in dialing button and a Pan/Tilt/Zoom camera. The video call to the care provider is initialized with one touch of the call button on the tabletop microphone. Futhermore, CS140 includes an integrated data channel for the parallel transmission of vital data. A range of low cost medical monitoring devices such as ECG, blood pressure, glucose levels, and weight measurement devices allow remote measurement of vital signs. The CS140 is also capable of displaying important messages on the client's screen.

At the care provider's premises, PC based call-center software allows remote control of the client's home station. If, for example, the television is switched off and the client

cannot hear the care provider, they can help by switching to the internal speakers of the home station in order to give advice such as to switch on the television. Furthermore, far end camera control, taking snapshots of the client, recording the video call and other functions are available. The transmitted vital data will be stored automatically in the client's dossier and allows analysis of the same. It is therefore easy to set alarm levels which trigger such functions as an email to a medical specialist, a nurse, or the relatives of the client.

V. FUTURE DEVELOPMENTS

Development and improvement by enhancing the functionalities of the system is a major contributor to successful introduction. In the future there will be content available via the television. Such content could be tailored advice regarding chronic diseases (diabetes, CHF, COPD…), ones own vital data history, physical therapy movies, online gymnastics, online shopping, online meal ordering, or relatives' access to a client's vital data. Another important issue is the inclusion of entertainment services such as online gaming (e.g. E-Bingo) or training for people with dementia or Parkinson's disease.

Whatever new developments eventuate, it is of the utmost importance that ease of use remains the highest priority. Among other improvements specially designed IR remote controls are needed and the user interface should be adapted for use by people with poor eyesight.

VI. CONCLUSION

The growing elderly population requires additional services and care, which increase quality of life while reducing costs. One of the major challenges for the successful implementation of video communication is the acceptance by the various stakeholders such as the care provider, the elderly, and their relatives. Since the elderly are often technologically averse, ease of use and the integration into existing home infrastructure such as the television set is critical. Additionally, Wakefield et.al states that usability, clinical appropriateness, training, and support will likely play a crucial role in the future growth of home tele-health. [5]. The authors of this paper therefore conclude that appropriate technology and well-trained staff will enable the successful implementation of video communication in home-care.

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A Multichannel Communication Platform for Healthcare: Case Studies

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Epidemiological background and public health relevance: To be able to cope with the multitude of needs in today's challenging communication environment, a communication system for disease management should be able to: (a) support all terminals in wide use (b) provide a horizontal approach as opposed to distinct vertical solutions (c) have open and flexible interfaces for integration. In a project started in 2000 a communication solution has been developed in Finland with these goals in mind. The end result is a system with a layered architecture, an optimised application server supporting software modules for specific communication tasks. Modules have been developed for instance for handling of e-booking, collecting home measurement results from patients, different questionnaires and queries, peer-to-peer support, safe messaging etc. On top of the modules a solution layer allows for xml configuring of solution specific features. A specific solution always fulfils the three basic requirements listed above.

The communication solution has now been used in close to 50 installations in Finland, Norway, United Kingdom, France and the United States. We will present a selection of projects:

1) Medication Management

Helsinki City Home Healthcare, implementation for 400 patients including an automatic drug dispenser capable of sending messages to server, reminders as automatic voice phone calls

2) Treatment and medication follow-up

Turku University Hospital, implementation for the department of surgery. Automatic treatment follow-up questionnaires to patients with reminders, multichannel support for answering.

3) Multiplayer e-booking

Tampere University Hospital Central Laboratory. E-booking for local hospitals, health care centers and directly to patients. Received the Millenium Technology Honorary Award in 2005.

4) Asthma self management solution

A major UK company's pilot for 30 asthma patients in occupational healthcare. Wireless uploading of spirometer values through mobile phones, mobile symptom and medication questionnaires, mobile reports. Reminders as SMS messages to patients.

5) RFID Communication board

The Finnish Alzheimer Society's pilot to provide easy structured messaging to early phase Alzheimer patients.

6) Parkinson's Disease Support Network

A comprehensive e-service for Parkinson's patients, their families and professional caretakers in Surrey, England. Evaluated by Imperial College.

Keywords: e-health, communication, e-booking, home measurements, questionnaires, RFID, chronic disease, disease management.

A semantic-based healthcare information infrastructure able to integrate medical information and eHealth services

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Abstract-In response to one of the most important issue in the European healthcare system, the medical errors and the diagnostic and therapeutic risk management, a national health information infrastructure is needed to provide immediate access to complete patient information and decision support tools for healthcare professionals and to capture patient safety information as a by-product of care using this information to design even safer delivery systems. Better management of health information is a prerequisite to achieve patient safety as a standard of care: this represents the main pillar on which the researches presented in the paper will be based. The result of the project technological researches is a semantics-based healthcare information infrastructure that provides, for each patient, the General Practitioner with the necessary information to minimize diagnosis and treatment errors.

I. INTRODUCTION

Improving patient safety by reducing medical errors has become a business necessity. The most of the medical errors are related to knowledge errors [1]. Knowledge errors include those that relate to a lack of access to clinical knowledge or skills, such as a doctor prescribing the wrong medication due to incorrect information in the patient's chart.

The principle reasons for these problems are lack of uniform access to new knowledge, and insufficient resources to deliver its benefits to all [2].

Poor communication is at the heart of the vast majority of complaints about healthcare professionals' performance. Misdiagnosis sometimes results from a failure to listen to what the patients say about their symptoms, or dismissing their concerns too hastily.

For instance, in the UK the majority of GP consultations last less than 10 minutes, so it is hardly surprising that some professionals feel they do not have sufficient time to get across the information they feel is important, and to be ready to completely take care of his responsibilities assumption in mainly patient diagnosis and treatment processes [3].

Moreover, in modern, science-based medicine, the traditional process of care - one clinician looking after one patient - is being replaced by one in which the patient is managed by a *multidisciplinary team* of health care professionals, such as oncologists and cardiologists working with general practitioners and home-care nurses [4]. The effectiveness of such shared care depends critically on the ability to share patient specific information and medical knowledge easily among care providers. Indeed, it is widely recognized that the inability to coordinate information and services across organizations represents one of the major impediments to quality care and that we need to take a more process-oriented view of health care delivery with appropriate organizational and information infrastructures.

Presenting the right knowledge to the right medical personnel in the right place and at the right time is of paramount importance in making critical medical decision. Driven by this paradigm, COCOON, a European Community funded research project, concerns the development of a knowledge-based approach to diagnostic and therapeutic risk management.

The aim of this paper is to show the main results of the project technological researches: a semantics-based healthcare information infrastructure is designed to offer interactive support to healthcare professionals, assist them to efficiently handle complex medical cases, such that diagnosis and treatment errors are minimized, potentially saving lives and the rising costs of healthcare and malpractice suits. Providing infrastructure for proficient knowledge sharing and transfer, this approach can significantly improve knowledge-driven collaborative practices among healthcare communities in Europe and provide a test bed for similar efforts elsewhere.

II. OBJECTIVES

The risk management for an health care professional is completely related to its responsibilities assumption in mainly patient diagnosis and treatment processes. The growth of patient judgment autonomy and level of information together with the assessment of cost/benefit before to decide intervention actions are three important factors that force the health care professional in pay much more attention in providing the right answer to the patient problem. The increase of both juridical trials and the health care insurance costs for the health care professional for covering the medical error effects, are two important indicators of the relevance of the problem at European level [5].

To prevent this issues the health care professional have established various association forms such as real associations or just informal communities that help the health care professional in sharing the risk and doing the right thing for the patient.

None of them are really supported by an IT solution powered for enhancing the risk management process.

The starting point of the project researches is a multi-directional technical investigation aimed at setting up a semantics-based healthcare information infrastructure with the goal of reducing medical errors; the result will be a toolset of interoperable, scalable and reusable Web Services supporting "Community & Knowledge Management" practices in a wide range of networks of healthcare professionals. The semantics-based healthcare information infrastructure is able to seamlessly integrate information and services. Such infrastructure, for each patient, will provide the general practitioner with the necessary information from the health records, the appropriate clinical guidelines, the relevant and updated research evidence, the information regarding available medical services, technologies and medications, their efficiency and side effects, possibly even the experience from other similar cases and a specialist's advice.

The architectural design will be defined together with the two main types of tool services: Semantic Information Retrieval, which employs concept-based indexing, and Decision Support, which is based on selected clinical guidelines. Semantic Web Service technologies serve to glue these services in existing healthcare information systems.

The technological researches at the basis of the paper aim at providing, for each patient, the general practitioner with the necessary information from the health records, the appropriate clinical guidelines, the relevant and updated research evidence, the information regarding available medical services, technologies and medications, their efficiency and side effects, possibly even the experience from other similar cases and specialists' advice.

III. METHODOLOGY

The methodology adopted in order to arrive at defining a new semantic based HC infrastructure that supports and enables knowledge driven and dynamically networked communities foresees different fields of research that will flow into a unique "Overall Analysis" that permit the construction of a complete solution.

Three important aspects were considered when defining the working methodology:

- the individuation of some business scenario and use cases, derived by an analysis of the technological, infrastructural, functional, financial and commercial aspects over both the project life cycle and the market deployment phase;
- the production of an economic and business plan to analyse acceptance of the services envisaged in the researches on the basis of a commercial demonstration;
- the redaction of a detailed business plan addressing al the elements necessary for the investment decision, including economic and commercial aspects related to the deployment of the service platform in view of the technological development of the healthcare professionals.

Even if these researches deal with different issues, the priority is to merge them into a single and integrated vision, which unifies User Requirements with the suitable Technology and with the correct Organisational, Political, and Economical features.

Although the public action and emerging collaborative practices concern many healthcare communities involved in specific health care processes in networked organisations (encompassing hospitals, health care professionals, general pratictioners, research centres, public administrations, patients and their families, etc...), the general evolution should not hide the wide diversity of communities and underlying behavioural logics, e.g.:

- peer collaboration mechanisms start being implemented through peer consultation processes among specialists for instance in specialty networks dealing with diagnosis, treatment and surgery of rare disease;
- coaching mechanisms are also implemented by specialists to support other professionals and sometimes patients' families, for instance for palliative care of patients maintained at home;
- strict coordination mechanisms are also implemented to support just in time processes such as those relating to the procurement of organs.

Each year an International Workshop and three Regional (National Level) Workshops are organised in order to presents results and conclusions to a group of experts operating in the field. These people are invited to both present their experiences and to comment on the outcome reported by researchers. These are important and meaningful moments of reflection that imply a confrontation with the Community and that could really help researchers to eventually re-address the direction of the analysis.

IV. TECHNOLOGY DESCRIPTION

The architecture (see figure 1) is designed to provide two main functionalities: Semantic Information Retrieval (SIR), which enables the end-users to query (at a Semantic Level) multiple heterogeneous unstructured content sources, and Decision Support System (DSS), which operationalizes Clinical Guidelines into a concurrent set of rules that are run against the data stored in the patient records and include both diagnostic and treatment activities.

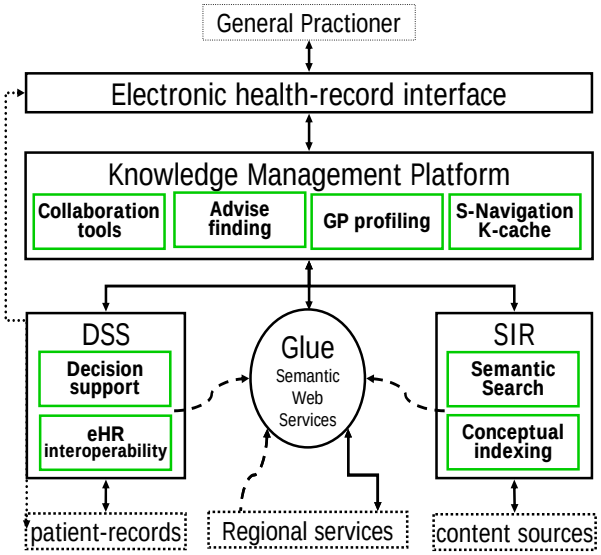

Figure 1: The architecture

Since this complex information must be provided to a General Practitioner in real time, during his/her interaction with a patient, the eHealth services must be presented via the standard health record interface the GPs are already accustomed to. However, a Knowledge Management platform is hidden behind in order to provide an integrated set of services that interconnects and complete the two main functionalities with

- a tool for navigating the semantic information infrastructure [9] in a personalized way,
- a tool for finding other colleagues on the basis of the problem a GP likes to receive advice [7],
- a set of collaboration tools, and
- a tool for caching (in a sort of extended memory) the most interesting knowledge item founded in the interactions with the system.

Last, but not least, since many complex technologies must be integrated in a seamless way, the architectural design decision was taken to expose all functionalities as Web Services and to Glue [7] them together by the means of Semantic Web Services [8]. Such a Glue can also be used to link into the system the service offered by the regional healthcare systems (e.g. the CRS-SISS of Lombardy - Italy).

V. Developments

The core feature of the presented researches is to collect, identify and study in practical terms current and emerging need of GPs and healthcare professionals in the framework of new interoperability and collaborative Community of Practices enabled by a semantic healthcare information infrastructure. In order to do that, committed Healthcare Regional Authorities, such as Lombardia Region (Italy), the Bruxelles Region (Belgium), and the Epirus Region (Greece) have been directly involved.

Concerning the "Semantic Information Retrieval", today, if an organization wants to offer an information retrieval solution able to query simultaneously many content sources, even using the best tools available on the market it needs to perform some time-consuming tasks: the manual integration of different context sources and the manual annotation with metadata to complete the work of the word-based indexing. Often a thesaurus is used to provide Semantic Search, and to achieve personalisation and homogeneous navigation through content sources. An example of this approach is PubMed that is based on MeSH (the thesaurus) and Entrez (the manual integration of around thirty databases). On the contrary, a semantic base solution (where thesauri are substituted by ontologies) automatic concept-based indexing of content sources and semi-automatic integration of content sources becomes possible. Moreover such ontologies can also be levered at the level of personalization and navigation. In respect to the previous, this approach grants a better usage of time and better support for the practitioners;

As regards the "Decision Support System", today, the use of Clinical Guidelines assumes a process made up by several phases that in practice does not appear sustainable [11]. Initially, medical experts and specialists start a consensus process reviewing literature and evaluating medical evidence. This process permits the creation of Clinical Guidelines that are reviewed and approved by the medical community and then published and disseminated. The GPs will receive the Guidelines, read them and, internalising the concepts, they will be able to give benefits to the healthcare process. This better care process provides feedbacks and motivations to the medical experts that improve the guidelines; the sequence of these phases is a virtuous cycle. Unluckily, in real life, this is only partially true since it's difficult arguable that the GPs will internalise the guidelines and, so, they will not follow the guidelines in real practice breaking down the cycle.

On the contrary, the "operationalization" of the Clinical Guidelines in Computer Interpretable Guidelines may help in closing the cycle. In this concept, apart from keeping disseminating the paper guidelines, such guidelines are made computer interpretable and deployed in the DSS which is interoperable at a semantic level with the electronic healthcare record. So, if it's true that the General Practitioners still need to read the Clinical Guidelines, however their internalisation is supported directly by the eHR which provides the GPS with suggestions during the care process. Through the DSS, we supply hints to the General Practitioners who can really provide benefits and a better healthcare process keeping in life this virtuous cycle.

A key problem that COCOON is addressing is the maximum decoupling between the DSS and the eHR, in other words, the coding and the execution of the Clinical Guidelines must be independent from the actual data structure used by the various eHR. COCOON believes a possible solution is in Semantic Interoperability obtained by translating the various eHR dependent messages in a common message (e.g HL7 CDA using SNOMED as vocabulary). Along with other efforts both at European [8] and international level (e.g. RIM in HL7 and archetypes in openEHR) we are developing an interoperability layer based on WSMO [10].

VI. Results

Considering the described development, three business cases for the technical researches applications and demonstration have been identified as main results:

- Supporting diagnosis and treatment by the means of computer interpretable guidelines: the possibility to transform a clinical guideline into series of steps that may include diagnostic and treatment activities and its integration with the patient's electronic health record, offers a set of recommendations regarding the next step(s) to be taken. Due to the fact that application of Clinical guidelines can differ significantly for various patients' profiles, depending on such factors as demographics, medical history, age and gender; selecting the most appropriate medical guidelines for each individual patient is thus of utmost importance. The Decision Support System accomplishes this through a "super" guideline that systematically compares personal background information with medical profiles and employs complex heuristics in order to evaluate which medical profile is most suitable for the patient being treated. The Decision Support System also consults pharmaceutical databases to match medications to patients and detect individual counter-indications. Moreover, the system provides some support to the care delivery phase preparing a workflow of treatments and examinations for the patient. The system builds workflows taking into account some parameters such as patient current residences, their mobility, their urgency, amount and modalities of payment, etc..
- Continuous personal medical education: the developed system provides the general practitioners with a Knowledge Management platform which gives access to heterogonous and distributed medical information included in medical journals, clinical guide lines and any free text document each Region makes available to its general practitioners. The Knowledge Management platform allows the general practitioner to homogenously navigate the results, deepen or generalise the search and cache valuable information. The system offers also the opportunity to store the query (in relation to a specific medical information) so that the system can push to the general practitioner new relevant documents which increase and update his/her knowledge cache. The main result is not on the functionalities that are often available in most of the commercial knowledge management product, but on the scale such solution can be applied. In other words, ten years ago only the National Library of Medicine would be able to build a solution such as PUBMED, whereas the use of knowledge technologies makes this affordable at a regional level an for regional content sources.
- Advice support: this result aims at supporting healthcare professionals in finding the most appropriate group of experts to ask for an opinion. This is a simple scenarios were no integration among the services is needed (because the healthcare professionals have a common instant messaging platform), but semantics might help in finding exactly what is needed. Once the group of experts has been identified, the involved actors can exchange information and share data via the multi-channel collaborative work platform. Moreover the results of the work sessions might be indexed using the system ontology and stored for a future use. In this way a part of the tacit knowledge exchanged in the collaborative work sessions can be made explicit.

VII. Business Benefits

The Knowledge Technologies for the corporate market is an extremely tough and competitive market segment with few big and well-established players: Convera, Verity and Autonomy pretty much divide the Enterprise Information Portal (EIP) market between them, IBM with the WebSphere, and most recently Masala, Microsoft with the Backoffice solutions, and SAP with their ERP solutions completely dominate the corporate knowledge market. Nevertheless, this current offer is suitable for the strong, centralized intranet environments, but not much adaptable to the largely dispersed environments, such as typically encountered in the communities of general practitioners – targeted by COCOON. These communities do not share a powerful intranet infrastructure, and have limited resources for the knowledge technologies that are actually not their "core business". Accordingly, not much of the Knowledge Technologies is currently adopted in these communities, and there is no particular application or solution specifically designed to assist them in their search for accurate and relevant information.

COCOON is developing a system specifically designed to allow the communities of general practitioners to access and benefit from the Knowledge Technologies. To this purpose, COCOON introduced several innovations beyond the current state-of-the-art and beyond the current market offer:

1. To counter the greatly dispersed location of the end users, COCOON is developing a web-based solution (rather then an intranet solution), allowing a pervasive access from any desktop. This solution is based on the cutting-edge Semantic Web technologies, introducing the Web Services discovery functionalities as its key-innovation, and thus becoming one of the leading implementers of this novel technology that was until now considered to be only an experimental "technology of the future". Actually, the COCOON Glue Discovery Engine is the first of its kind to bring WSMO Discovery into the real worlds in a end-user application.
2. Its information retrieval functionalities COCOON is basing on the combination of federated search technologies with the state-of-the-art semantic technologies, utilizing the ontology engineering specifically designed for the medical domain. The result is a search and retrieval solution embedding machine reasoning utilizing the Semantic Web technologies, and allowing simultaneous access to multiple, distributed content sources in the medical domain. Accordingly, COCOON offers information retrieval competing with the best of offer in the corporate market, but accessible to a highly dispersed community, and specifically designed for the medical domain.
3. To counter the problem of insufficient resources, COCOON introduced grid technology, allowing community with scarce individual resources to build powerful knowledge solutions by sharing their computational and storage resources. The computationally demanding tasks of text processing are performed on the grid, combining individual resources of every participating community, rather then requiring a massive investment into their IT infrastructure.

By combining these innovations with the state-of-the-art applications for health records management and clinical guidelines support, COCOON is developing a novel and exciting product for the market segment that although not yet established, bears enormous market potential. This opens an exquisite business opportunity for COCOON to seize the leadership in the Knowledge Technologies market, targeting medical practitioners in general, and general practitioners in particular.

Concerning the exploitation of researches outcomes for the industrial component of the project consortium, this will mainly result in the commercialisation of the prototypes produced within the project. All prototypes will be used as basic elements to develop and produce marketable results: as in-house developments by each partner and in collaboration with project partners. A quick process of research transfer in production will assure to the Consortium partners an essential competitive advantage for a further consolidation of the respective positions on the market. The specific techniques implemented in the project will be used by most of the Partners to enhance the techniques already in use, contributing to consolidate a competitive advantage.

VIII. CONCLUSIONS

The innovation of the project researches consists of supporting knowledge driven collaborative practices in Networks of Healthcare Professionals in dealing efficiently with complex case, in order to minimize medical errors in diagnosis and treatment and raising quality of care and to join knowledge driven and dynamically adaptive learning communities in which healthcare professionals and citizens are fully knowledge driven in taking promptly the best possible decision for prevention, diagnosis and treatment. The system will increase collaborative practices amongst the healthcare communities, supporting knowledge sharing and transfer. This should be one of the major evolution that characterizes healthcare in Europe in the coming future [5]. The rationale for such public action is that since healthcare is the archetype of a knowledge intensive sector, providing the right information to the right place at the right time to the right persons is a critical quality factor.

To support the objectives of healthcare delivery that is free of errors and the implementation of robust safety reporting system a broad range of patient data will be needed, included sign and symptoms, test results, diagnosis, therapies and outcomes; future challenge include the involvement of the other 10 European regions in the project in order to store the platform with as much as possible data.

In close future, prototypes of the system described will be deployed in pilot sites (Bruxelles, Epirus and Lombardy Regions); in particular, the first prototype will be implemented in Lomabardy Region in October 2005.

The choice of the pilot sites and the sample of General Practitioner to involve in the trials required researches and an accurate analysis.

The defined path consisted of following four steps:

1. interviews to Regional HC system in order to analyse the context at Regional level;
2. analysis of the data existing for each relevant interaction process/activity between GPs/specialists and HC system (we speak about GPs for Lombardy Region and for Bruxelles Region, about cardiologists for Epirus Region);
3. analysis of the Electronic Healthcare Record Software and the related normative rules which mainly characterise the three involved Regions;
4. definition of the field trial area in order to identify a representative sample of the GPs/specialists belonging to the field trial;
5. direct involvement of the selected sample of GPs/specialists.

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Telehomecare in Palliation Study (Tips): Real Time Videoconferencing Support for End of Life Care

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Purpose

Evaluation of the impact of home telehealth, for palliative cancer patients and their primary caregivers. The study will focus on utilization of health care services, quality of life, pain and symptom management, and satisfaction with service.

Methods

Newly referred patients to the Temmy Latner centre for palliative care, who meet eligibility criteria, are randomized using a computer generated randomization system in to one of two groups; Standard palliative home care or modified standard palliative home care plus home telehealth.

Home telehealth consists of a multidisciplinary team of health care professionals providing care via an internet based videophone.

Patients and nurses have in home DSL internet connections supporting real time conferencing.

Evaluation is conducted every two weeks for a six month period., by a research assistant, administering a series of surveys over the regular telephone.

Satisfaction of the professionals involved, with home telehealth will be evaluated.

IT

The set up of secure and robust home telehealth delivered challenges and surprises. Hardware and software exhibited bugs. Provisioning of DSL and telephone services was unpredictable, and integration of all the pieces into a workable operating system was difficult.

Results

Recruitment is now complete. 113 patients and 71 caregivers have been recruited to the study. Patient care and surveys will continue until April 2006.

Integration of new technology in the health care field has many different challenges.

In home telehealth the consequence of even minor technical difficulties can have severe, negative consequence on patient care and perception of quality.

Keywords: Telehealth, homecare, end-of-life care.

Session 3

Healthcare Challenges

Dokter.nl Digital Consultation

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Abstract- Dokter.nl Digital Consultation (www.dokter.nl) offers medical consultations over the Internet. Dokter.nl is accessible to anyone, anytime, anywhere, fast and easy.

I. Introduction

The demand for medical services is increasing while the supply is insufficient. Cutbacks and lackof trained staff lead to a shortage of GP's, waiting lists for medical specialists and dissatisfied patients in the Netherlands. Doctors find it increasingly difficult to deliver the care patients deserve.

The autonomous consumer needs the option of personal, reliable, easy and quick doctor consultation. Dokter.nl Digital Consultation (DDC) is an innovative contribution to health accessibility by increasing consultation efficiency with Internet solutions. The entire health care process, from client, triage and doctor to consultation and secure medical file is incorporated in one Internet application.

Therefore the DCC saves both time and money.

II. DDC

The client visits www.dokter.nl where an online personal Digital File is created with username and password in a secure environment. This is where the client composes a question to the doctor. The Dokter.nl triagist refers the question to the appropriate specialist, who is then notified through e-mail and SMS. The specialist logs on to the secure personal doctor file and answers the question. The finished consultation is then sent to the client's file, who is notified through e-mail and can log on to the personal Digital File and read the doctor's answer to the question. If someone has multiple questions the answers are all gathered in the personal Digital File. This way patients manage their own online medical files.

III. General

Dokter.nl Digital Consultation (www.dokter.nl) is safe accessible to anyone, anytime, anywhere, fast and easy. Dokter.nl service providers have access to the DDC from their workplace. All major medical specialties are represented in the dokter.nl team.

IV. Technology

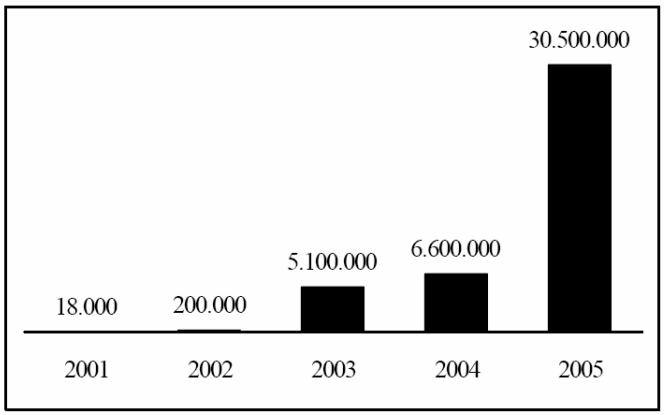
The website and additional features are based on Internet technology. DDC applications are PHPbased. Databases and open source technologies are integrated to the highgest degree in the DDC. A professional partner takes care of hosting the website on a SSL-protected server.

V. URL

Dokter.nl registered the URL's in the Netherlands: www.dokter.nl, www.arts.nl and www.huisarts.nl.

VI. Results

Fig. 1. www.dokter.nl visitors



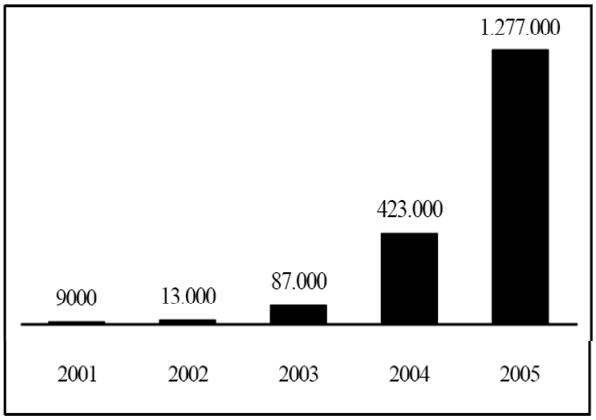


Fig. 2. www.dokter.nl pageviews

2004: best practice “European eHealth Award”, nominated by department of Health best websites of the Netherlands “Elsevier”

“Broos van Erp Award” nominated by department of Economics

2005: “National home shopping Awards”

VII. FINALLY

In health care both the risks and interests are great. Innovations in health care are difficult and slow. There’s a shortage in funding and support for innovative changes. Regulations and guidelines from the government are tailored to already existing processes. Health insurance companies concentrate on risk assessment and are only willing to comply when the advantages of innovation are recognized and demonstrated.

Dokter.nl is independently developing a best practice with medically reliable solutions without government or health insurer support. Dokter.nl is a combination of visionaries from the old hierarchic health care structures with the courage and zest from practical entrepreneurship.

Dokter.nl develops and produces efficient and personal health care solutions.

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PARKSERVICE: Home support and walking aid for people with Parkinson's disease

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Abstract-PARKSERVICE is a telemedical application currently being validated in the EU. The objectives are to provide a combination of home clinical and social support for people with Parkinson's disease with a revolutionary walking aid that uses "visual cues" to enable improved mobility. Early results are presented and the outlook of home telemedicine and visual cueing for people with PD is discussed.

I. INTRODUCTION

PARKSERVICE is a new telemedical application combining home-based support for people with Parkinson's disease (PD) and a PD-specific walking aid which uses a strategy known as visual cueing. PD is estimated to affect 100-180 per 100,000 of the population (with most surveys favoring the higher estimate) and has an annual incidence of 4-20 per 100,000[1]. Taking a population of approximately 450M citizens this implies 450,000-900,000 people with PD (PWP) in the EU.

PD is a progressive, incurable neurological disease resulting in depletion of the neurotransmitter dopamine in the brain. Currently all therapy is symptomatic and primarily based on pharmacological enhancement of dopamine levels via the drug *levadopa*.

The three cardinal signs of PD are *bradykinesia* (decrease in movement), r*esting tremor* (shaking, usually of the extremities of the limbs) and r*igidity* (muscular stiffness, cramps). As the disease progresses PWP typically suffer from gait abnormalities, falling and periods of complete immobility (*akinesia* or "*freezing*"). Additionally there are complications associated with long-term use of levadopa, including daily *fluctuations* between "on" periods of good symptom control (normal mobility) with "off" periods of poor symptom control (poor mobility) and even *dyskinetic* periods of exaggerated poorly controlled mobility. Transitions between these phases are primarily associated with the concentration of levadopa in the blood, but can be triggered precipitately by tiredness or stress. Episodes of "freezing" can occur in either "on" or "off" phases, although on-phase freezing is rare and difficult to treat[2]. Freezing is associated with falling and heightened levels of anxiety. Falls are common in PD: two thirds of people with PD fall each year with most eventually becoming fallers [3].

It is well known that some subjects who experience freezing can suddenly and dramatically "break out" of their frozen posture in the presence of particular cues, the nature of which vary with the individual. For example, some PWP who are unable to walk normally can dance to music, walk over obstacles, stripes or up stairs or when emotionally stimulated. (PD literature includes episodes of paralyzed PWP running out of burning buildings). Enhanced mobility under these conditions is known as *paradoxical kinesis.* (This is described in more detail below.)

Good management of PD requires clinical specialists both for accurate diagnosis and regular follow up. Periodic adjustments of drug regime are normal. Management is complicated because of the difficulty PWP experience getting to clinics, and in *fluctuating* PD, because the PWP may present few disabling symptoms during an appointment. Additionally there is a European shortage of neurologists [4].

PD is an expensive disease. In the UK the total annual direct cost of care including NHS (National Health Service), social services and private expenditure per patient have been estimated at ~€9,000 (£5,993, 2003) per patient per year [5]. With a total UK population of 60M this implies a total direct cost of PD in the UK of ~€1,000M (2003).

The same study estimated total annual direct costs of €6,300 for patients living at home, €23,260 for patients whose time was divided between home and an institution and €29,300 for patients in full-time institutional care.

Thus, every year someone with PD can stay at home, rather than take up part-time institutional care, saves (UK, 2003) €14,000/year.

The relevant aspects of PD can therefore be summarized as follows: PWP suffer varying and complex symptoms associated both with the disease itself and with the long-term use of levadopa, the primary pharmacological therapy. The effects of PD are particularly profound on mobility (with associated loss of confidence and social exclusion). Some PWP display a startling recovery of mobility in the presence of "cues" such as stripes on the floor. The management of PD is complex and expensive, both in per-patient terms and in total (since PD is a widespread disease). PWP may experience difficulties finding suitable neurologists, traveling to clinics, and describing symptoms whilst there.

In many ways, therefore, PWP present an excellent group for telemedicine: the disease is widespread, affects mobility, there is a shortage of neurologists and treatment is expensive. The presence of *paradoxical kinesis* also presents intriguing possibilities for enhancing mobility (which are described below).

II. PARKSERVICE

PARKSERVICE is an application of telemedicine targeted specifically at PWP. The service consists of three parts: PARKLINE, a TV-based communication system for the PWP at home, PARKCLINIC, a complementary system for clinicians and INDIGO, a mobility aid for PWP mediated through PARKLINE.

Firstly, through PARKLINE, a PWP is connected through the Internet to their clinician and to other PWP. The primarily medium of interaction is exchange of off-line video which can take place via broadband or dial-up connection. PWP can make short videos of themselves using a web-cam controlled by television remote control (via a multimedia PC). The objective is to provide a simple user experience with push-button interface. After taking a video the user can review it, reject it or distribute it to a list of other PARKSERVICE users including their own clinicians.

PARKLINE also supports other ways of data exchange: particularly a symptom diary (which is useful for understanding a patient with fluctuating PD) and text messaging (which obviously requires a keyboard).

Secondly, since PARKLINE requires special hardware to enable user access PARKCLINIC has been provided for secure clinical access through web browsers. With PARKCLINIC a clinician can view videos uploaded by PWP at home, send text messages to them or upload videos of their own.

Thirdly, INDIGO is a new mobility aid which uses video delivered through a pair of glasses to trigger *paradoxical kinesis* in suitable PWP.

Therefore, using PARKSERVICE a PWP at home can video their evolving symptoms of PD and their response to different drug regimes. They can experiment with visual cueing, exchanging video records with their clinicians and other PWP. For those PWP who exhibit *paradoxical kinesis* a secondary component of PARKSERVICE, INDIGO, can be used to enhance mobility throughout and beyond the home.

III. TELEMEDICINE AND PD

As long ago as 1993 a pilot study of telemedicine for patients with Parkinson's disease demonstrated the possibility of dependable and valid remote-assessment of these patients. Patients also viewed this technology as enabling access to better health care [6]. This result was confirmed in 2002 in a study which included the adjustment of PD medication via videophone [7]. However, few research initiatives have made an impact on the market. This is unfortunate because PWP represent a particularly appropriate population for telemedicine for the following reasons:

- The disease is widespread
- Clinical treatment is expensive
- There is a shortage of neurologists
- Travel is difficult
- Assessment by video has been validated
- Some PWP react strongly to appropriate video stimulation (*paradoxical kinesis).*

Therefore the opportunity exists to make a cost-effective case for telemedicine beneficial to people with PD.

IV. INDIGO AND PARADOXICAL KINESIS

An important component of PARKSERVICE is a mobility aid called INDIGO. INDIGO consists of a pair of glasses with integrated visual display and wearable electronics which feed visual cues to the wearer, triggering *paradoxical kinesis* in suitable PWP.

Many people with PD have difficulty initiating and sustaining walking in conditions which would normally present no problems (such as an unobstructed corridor). The degree of these mobility difficulties can vary with the subject, the time of day and the stage of disease but are always accompanied by severe loss in quality of life. Typically when people with PD can only move very slowly or completely freeze (phases called "*bradykinesia*" and "*akinesia*" respectively) they feel vulnerable and isolated. Accompanying symptoms include an expressionless "masked" face, a weak voice and bent posture. Social interaction becomes extremely difficult and each year many deaths and injuries occur as people with PD attempt to move whilst in this state.

Paradoxically, when visual "obstructions" are placed in their way, a small proportion of people with PD undergo a dramatic release from these symptoms and can suddenly stand up straight, speak strongly and walk normally: an effect called *paradoxical kinesis*. These "obstructions" can be as simple as pieces of paper set down on the floor and are usually referred to as visual "cues".

The physiological mechanisms of *paradoxical kinesis* are not understood and until recently there was little opportunity

to analyse it or exploit it. However, technology has now evolved to the point where a user, wearing adapted glasses, can see visual cues, such as virtual "pieces of paper" wherever they looked whilst continuing to negotiate the real world, interacting normally with other people. This allows certain people with PD to walk, to talk and to socialise where before they were effectively paralysed.

Visual cues do not trigger *paradoxical kinesis* in all PWP but the number of suitable PWP and the nature of the visual cueing that is most effective is not known. It is believed that PWP in the intermediate stages (II-IV on the Hoehn-Yahr scale of I-V) respond. In earlier work we estimated 15% of this population would benefit from visual cueing but this was not statistically significant. [8]

It is therefore expected that PWP will need to experiment with different visual cueing, by downloading selections of video on to their home television. If they find they respond positively the PARKSERVICE consortium will provide an appropriately configured INDIGO.

Figure 1. INDIGO in use with darkened glasses.

To date, the most popular choice for visual cues has been simply black and white stripes scrolling upwards. [8]

V. MARKET VALIDATION

Validation trials of PARKSERVICE will take place in summer 2006 involving several associations of PWP and clinical investigators. Additionally independent clinical trials of INDIGO will take place led by the Institute of Neurology, Lodon. The major areas of investigation are listed below:

Drug management by video: the clinical assessment of PWP by video. This has been investigated before – if these results can be confirmed this would be of enormous importance to the market validation of telemedicine for PWP.

Social inclusion of PWP: do PWP report a greater feeling of connectedness to their clinicians and other PWP given the ability to make and exchange messages from home, principally by video.

Walking aids based on visual cueing: INDIGO, and devices using cueing, have become increasing available in the last few years. However, none has become a mature product. This may be due to a lack of clinical validation of this new device which should be addressed by clinical trials.

In addition to these issues, to be addressed this summer, a market analysis has been performed. Recalling that PARKSERVICE is aimed at users who have Parkinson's disease with targeted symptoms living at home who have or could get Internet access and taking prevalence figures of 100-200 per 100,000 of the general population, adjusting for disease stage, Internet availability, and possible co-morbid conditions such as dementia, we estimate 180,000 to 360,000 potential PARKSERVICE users in EU-25. Interestingly, 60% of the PD telemedicine market lives in UK, France, Germany and Italy.

We also examined the trends in the PD market for telemedicine. The patient population will steadily grow, due to the combined effect of the growth in the general population in Europe and of the longer life expectancy of ageing people and PWP in particular, but these demographic effects will be dwarfed over the next few years by the effect of Internet penetration into European households. Considering an unchanged prevalence of PD, we estimate an increase of the population of PWP by 6,000 between 2006 and 2008.

The PARKSERVICE market validation project receives support from the European Commission's e-Ten initiative in Information, Society and Media.

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Telemedicine against Bioterrorism

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Abstract-Infections are known as the world's largest killer. They account for more than 13 million deaths a year. Most of these deaths occur in countries with low- and middle financed healthcare. All this becomes worse by the huge increase in migrating of large mass populations over the past decade, because of war, famine and natural tragedies. The careful and watchful attention to infections is necessary to avoid bioterrorism outbreaks.

The present article describes the new initiative which aims creation of the system for the development of an effective response by the civilian medical communities (public health) to the earliest stages infections widespread and biological attacks through the use of telemedicine possibilities that optimally coordinate efforts between civilian medical responders (public health) at national, regional and international levels. The present initiative aims creation of the system through which public health professional's activity will be implemented in the most comprehensive and cost-effective schema. The proposed objectives are:

1. Building of structure for effective emergency operations;
2. Developing an infectious-disease mentorship structure, in which knowledge of outstanding and experienced specialists and international organizations will become direct resource for rural and regional medical providers through application of telemedicine possibilities;
3. Develop and improve existing telemedicine infrastructure in Georgia.

INTRODUCTION

The last decades were characterized by the intensive development of info-communication technologies and their application for different aims. As a result of usage of mentioned technologies for healthcare aims the new field, telemedicine, was created. It is working out by the developed countries, but developing ones can use them in the most effective degree [1]. Telemedicine is rapidly developed and the tendency of optimization and development of its solutions in accordance with developing countries' claims could be observed. As a result medical service in the developing world could be turned into a communitarian and safe practice. Virtual healthcare become more and more realistic. September 11 created a fear of bioterrorism. In response, billions of dollars have been allocated to create networks to prevent and respond to a bioterrorist attacks.

Reference [2] have noted that a system designed to rapidly identify an infectious outbreak or bioterrorism attack and provide important demographic and geographic information is lacking in most health department across USA. Reference [3] has noted that SARS outbreak provided an opportunity to study the use and impact of telemedicine to detect and fight a global epidemic. In such case telemedicine was used as the umbrella term for technology applications that have a population focus and the potential to improve public health. This includes the Internet, but also other technologies such as wireless devices, mobile phones, smart appliances, or smart homes. In the context of an outbreak or bioterrorism attack, such technologies may help to gather intelligence and detect diseases early, and communicate and exchange information electronically worldwide [4].

DESCRIPTION

Considerable progress has been made in readying major public health centers to respond to infections and biological terrorism, but the development of an effective response during the early stages of an attack, particularly in the public health, requires more attention. Today's advanced state of information technologies, communications, remote sensing and computing capabilities for predicting complex system dynamics permits developing effective systems for improved response. For example, (1) communications systems that distribute information can be easily and effectively used for rapidly distribute information, (2) educational systems that integrate assessment, information dissemination and knowledge-building can be created and integrated to support a web-based distance learning and telemedicine portal. The

extraordinary circumstances of terrorist activities and more recently bioterrorism require that every healthcare professional be as knowledgeable as possible in diagnosis and treatment of infections. The present initiative is going to use the digital information technology (IT) and Internet-based communications to help ensure a fast and effective response to large scale infections. The idea is offering the concept of how the greater use of telemedicine can enhance and support the public health infrastructure. The purpose of the present project is the development of the system that possesses the Knowledge, Skills, and Abilities to:

- Recognize indications of a terrorist event;
- Treat patients and communities in a safe and appropriate manner
- Participate in a coordinated multidisciplinary community response
- Alert the public health system rapidly and effectively.

The present initiative's specific strategies are:

- Development of the public health professionals workforce through research, analysis and planning;
- Improvement of distribution and diversity of public health professionals to rural/urban underserved areas;
- Improvement of the quality of public health professionals practice and education.

The main actions are:

1. Virtual System of Public Health (VSPH) – to avoid duplication of effort and promote a more systematic and better coordinated approach to infections training and education. This VSPH will realize infections related telemedicine activities and assist agencies and institutions working to control and eliminate infections at the regional and national levels, as well as those which are towards educational, diagnostic and research communities at national, regional and international levels.
2. Strengthen and maintain collaboration with global partners – this action extends the reach of infections training and education efforts beyond the borders of the concrete country. There are several reasons why this is important. One is that the spread of infections epidemic around the world constitutes a major global health crisis. It is beyond the capacity of any single nation to deal with the epidemic effectively. The same can be said according bioterrorism attacks. Therefore, all nations share the responsibility for addressing cases of bioterrorism and infections epidemics, for humanitarian as well practical concerns. Another reason is the objective, that the amelioration of infections crisis elsewhere will have the beneficial effect of improving their control in developing countries.
3. Develop, improve, facilitate access to and maintain availability of infections training and eLearning resources – eLearning methodologies and Internet-based courses, are likely to increase in significance and impact. They not only require the development of suitable material geared to such delivery systems, but also demand that users have access to the necessary technology. This can present a barrier to agencies and organizations that are smaller in size or have limited financial means. The objective is to ensure that excellent resources remain available, that users can obtain them readily and that new resources are developed or current one improved to address gaps in information and audiences.
4. Improve and sustain knowledge, skills and practices tailored to local epidemiological circumstances – the action articulates the result that infections training and eLearning activities are intended to achieve and that makes them effective strategies for making progress toward the prevention, control and elimination of the infection: the improvement of knowledge, skills and practices regarding infections.

JUSTIFICATION AND EXPECTED RESULTS

In the fight against the global spread of infections, telemedicine is being used to speed information to medical personnel and researchers and care for ill and injured patients wherever they may be. Furthermore, telemedicine networks have primarily benefited rural areas. But the development and expansion on the networks suffers from lack of funds and a piecemeal approach, making the creation of national or regional networks a bigger challenge. The military also is providing a boost for new telemedicine systems. In Iraq, military doctors are using telemedicine to provide instant care on the battlefield instead of waiting until a soldier can get to a hospital. Navy aircraft carriers are utilizing computer and teleradiology technology to treat patients in field hospitals. Much of the federal funding for and development of telemedicine is aimed at providing care in rural locations. The focus on infections and consequently on bioterrorism may stipulate planning and implementation of large-scale telemedicine projects. The present initiative is in soundness with all above mentioned; it will provide creation of the system which will realize real-time monitoring of infections and help develop a rapid-response strategy.

The proposed initiative will realize:

1. The clinical workflow for the aim to support the roles of different healthcare delivery teams which exist at the primary care levels. Interpersonal communication within the healthcare teams will be adapted to the primary, secondary and tertiary care levels.
2. Linkage of different vaccination and agent detection programs with the clinical workflow and the drug delivery and drug information databases.
3. Usage of digital telecommunication tools.
4. Implementation of an interdisciplinary collaborative approach.

The present idea has the potential to help public health officials make better decisions when responding to infections and especially bioterrorism outbreak. It will ensure the improvement of the level of preparedness against infections in general and especially against bioterrorist incidents.

The project calls for:

- Working with government stakeholders to identify appropriate methods for providing a worldwide integrated information an communication system with access by all appropriate agencies, healthcare providers and payers;
- To discuss and develop solutions of better identify and respond to a bioterrorist attack;
- Coupling with the Internet and building upon existing public health networks as a backbone for improving communication among healthcare professionals;
- Leveraging existing information technology to improve key processes critical to response to a bioterrorist threat. Doing this include: (1) developing real-time automated data collection tools to allow for rapid collection of information; (2) developing data mining, repository and analysis applications designed to rapidly extract and analyze information across multiple organizations, (3) producing communication tools to support the rapid transmission of information, (4) using web-based tools to assist in educating first responders.

The initiative ensures creation of the system in which the resources of public health will be added and enhanced by telemedicine possibilities. A clear demonstration of the cost-effective, clinical and technological benefits is expected.

It should be especially noted, that telemedicine is the new field, the wide application of which is at initial stage. This field requires a multidisciplinary approach involving varied sectors like telecommunications, IT, medical experts, general practitioners, hospitals, equipment suppliers, logistic companies, government agencies, social workers and universities. It also brings to the table a wide range of technologies like radio, analog landlines, e-mail, Internet, ISDN, satellites, and tele-sensors. The challenge in telemedicine systems is to harness new technologies and operating models while also improving equity in access to high-quality healthcare. The infrastructure for healthcare around the world should be based on new forms of communications and information technology like the Internet. The medical applications of telemedicine are many and specific, clear model will serve as a paradigm for global use.

Infections and bioterrorism are the top actual tasks worldwide. It is well known, that during the 2001 anthrax attacks, emergency response personnel, clinicians, laboratories, and public health officials were overwhelmed by requests for evaluation of suspicious powders and by calls from patients concerned about exposure to bioterrorism agents. Now the situation with Avian Flu is more and more anxious. The most possible and effective tool in the fight against infections and bioterrorism is the education and training of healthcare professionals in accordance with the approved and certified international standards. The possibility of distance communication is of great importance too. Taking into account all above mentioned the application of modern technologies and particularly of telemedicine for infections prevention and control and consequently for bioterrorism are novelty. The present initiative is the innovative and outstanding, it will combine resources of public health with telemedicine possibilities.

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Health Gateway - A mobile eHealth solution bringing point-of-care flexibility a step further

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***Abstract* - Timely review of patient data with close to real-time feedback is a critical success factor in today's disease management. This paper introduces eHit Health Gateway, an effective and secure tool to wirelessly transfer data from different measurement devices to the health care service provider by using a mobile platform. The system consists of a mobile platform, which collects the information from the measuring devices, and a server platform, which receives the collected data and forwards them to the existing Information System. The mobile platform can be used on most different devices such as mobile phones, smart phones and Personal Digital Assistants (PDA). An overview of the system functionality is followed by some important notes about security and privacy and by three reference cases illustrating the functionality of the system in different disease management environments.**

I. INTRODUCTION

eHIT Health Gateway represents an effective and secure tool to wirelessly transfer data from different measurement devices to the health care service provider via a mobile platform. It provides patient and nursing solutions ensuring that measurement results are available, accurate and both cost and time effective.

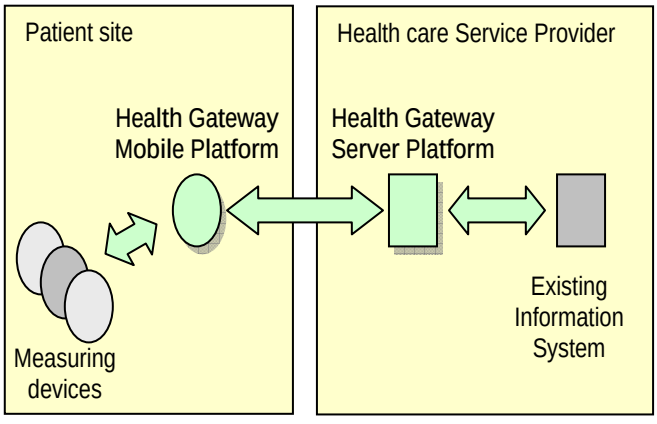


Figure 1. Health Gateway concept

The system consists of a mobile platform, which collects the information from the measuring devices, and a server platform, which receives the collected data and forwards them to the existing Information System.

The mobile platform can be used on different devices such as mobile phones, smart phones and Personal Digital Assistants (PDA).

II. WORKFLOW

A. *Collecting data*

A single mobile device can collect, store and transfer information from different measuring devices. This also makes possible the integration of devices from different manufacturers. For instance a blood pressure measuring device, a scale and a glucometer can be used to collect and register key information in diabetes care. The mobile device guides the patient and seamlessly collects information from the measuring devices. The patient can also follow his/her progress in the therapy directly from the display of the mobile device.

B. *Transferring data to the care unit*

The information is then automatically transferred to the health care provider by using a secure GPRS/GSM/3G connection. The received information can be stored in the Health Gateway server or directly forwarded to an existing information system. In this way measurement results are always accurate and they are available to the health care professionals in real-time and in the correct form.

C. *Receiving feedback*

Authorised personnel of the health care provider can browse the received data and send an almost immediate feedback to the patient by using the Health Gateway client application.

This bidirectional connection guarantees a faster patient treatment process as the patient can receive a feedback almost immediately.

The system is also capable of generating automatic alarms according to predefined algorithms. These alarms can be addressed to the health care professionals as well as to the patient.

III. CONFIGURATIONS AND MEASURING DEVICES

Health Gateway is a fully modular system, which can be delivered in different configurations ranging from direct

interface between the mobile platform and the existing information system, up to a complete system including centralised server and remote/local clients for data reviewing and editing. Health Gateway already interfaces to a broad range of measuring devices allowing for remote analysis of blood glucose, blood pressure, coagulation, body weight, heart rate, EMG, ECG, oxygen saturation, peak expiratory flow, and other parameters.

D. *Device integration problematic*

A common problem in integrating measurement devices to the mobile device is the connection between the devices. Today there are a lot of measuring devices communicating with cable or infrared connections. However most of the mobile devices can hardly handle cable connections and the infrared option is also disappearing from today's mobile devices as Bluetooth is becoming more and more a "standard" option for mobile device wireless connectivity.

To overcome these connectivity problems eHit has designed a special hardware adaptor module called eLink. eLink is a standalone, battery-operated and small-sized module that transparently converts measurement device cable and infrared communication into wireless Bluetooth communication. Thanks to eLink, a wide range of existing measurement devices, which would be otherwise impossible to interface, can be taken in use.

Figure 2. Use of eLink to enable an infrared connection

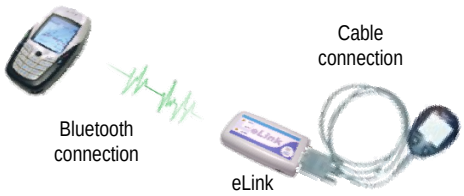


Figure 3. Use of eLink to enable a cable connection

A unique feature of the eLink adaptor is the "smart connect" function, which is the capability of initiating a connection to the measuring device. By using the "smart connect" function, the data extraction procedure from the measurement device can be initiated with the push of one button.

IV. Dealing with Security and Privacy Issues

When dealing with security and privacy issue, the first matter is to determine how secure the system should be. A low security level may lead to unwanted disclosure of sensitive data but on the other hand, high security level could make the system too complicated to use or would considerably raise the expenses of building the system. [1]

Local legislation and security policies of the organizations involved should define the security level required. Additionally, a threat analysis should also be done to assess the security level to guarantee the integrity and the availability of data as well as the privacy of patients' data.

It is important to note that technical issues are only one aspect of security. Threat analysis should also include threats caused by force major events, organisational shortcomings, human errors and deliberate acts. [1]

Systems like Health Gateway act as a bridge between the portable measuring device and the main information system, therefore the security analysis should be extended to cover the whole chain.

In this article we concentrate on the two links the Health Gateway Mobile Platform is concerned with. These are the connection to the measurement device and to the health care provider.

E. *Connection to the measuring device*

The first link of the chain is the connection between the measuring device and the mobile device. In most cases, data transfer here is performed by using a Bluetooth connection. Bluetooth is a short-range, low-cost, and small form-factor technology allowing for user-friendly connectivity among portable and handheld personal devices. [3]

Several studies have been done on Bluetooth security issues and the possible attacks an intruder could carry out [4][5]. The first matter is that on both devices security features shall be enabled. The devices should comply with Bluetooth security mode 3, so that they initiate security procedures before the channel is established. This mode is used in critical applications where security is mandatory.

The most critical phase of a Bluetooth connection is the so called pairing phase, where the devices exchanges information in order to establish a link key, which will then be used for encryption.

Since the initial exchange of keys is done using non-encrypted channels, this is the weakest part of the pairing procedure. It is recommended that the user should be in a "private area", before using the pairing procedure. According to Bluetooth SIG, an area is defined as "private" when it can be considered a place where you are confident that unknown devices are not in the neighbourhood. [6]

Another issue is the choice of the PIN code. During paring procedures, Bluetooth devices require a PIN code to be exchanged. This code should be long enough and configurable. Bluetooth specifications allow for up to 16-byte long PIN code. While 0000 or 1234 are very poor PIN codes, a string like "Pw3$Ud9Lab0A1s" would do a much better job by making the hacking attempts harder.

Also the procedures used to initiate the connection dramatically affect the security features of the system. Some measurement devices are designed to initiate the connection.

In the worst cases, the device searches for any Bluetooth enabled device that provides for instance a standard Serial Port Profile and tries to establish the connection until someone accepts it. As a consequence, the results might be sent to the wrong place and some unauthorized connections are tried. A slightly better solution would be a measurement device searching for Bluetooth enabled devices that provides a specific service (e.g. standard Serial Port Profile) with some specific predefined name. In this case the results are more likely sent to the correct place.

Definitely a better solution is having the mobile device to initiate the connection. In this case the connections can be handled in a controlled way, allowing for a more secure data exchange.

F. Connection to the Health Care provider

The mobile device usually sends the information downloaded from the measuring device to the health care provider by using GPRS/GSM/3G data transfer. This implies the use of an Internet Access Point and relying on services offered by an Internet Service Provider. Internet is a public network and therefore often considered insecure without proper security actions. However modern technologies offer several ways to make the connection more secure.

For instance establishing a secured communication channel between the sender and the receiver ensures data integrity and data protection. In HTTPS data transfers, the session data is encrypted using a version of the Secure Socket Layer (SSL) or Transport Layer Security (TLS) protocols, ensuring reasonable data protection. Virtual Private Network (VPN) allows for creation of a private communication network within a public network. Secure Shell (SSH) allows for secure logging into and executing commands on a networked computer.

A step further is reached by using Public Key Infrastructure (PKI). This technology is based on public and private keys and it enables users to be authenticated to each other, and to encrypt and decrypt exchanged messages.

Besides technologies, data security and data privacy is also affected by procedures. For instance privacy can be ensured by transferring anonymous data. Transferred data doesn't need to contain direct references to the patient ID. Instead the id of the measuring device can be transferred and the link between the patient and the data can be at the health care provider site. In case a malicious eavesdropper would intercept the transferred data, this could not be easily linked to the patient.

V. Reference Implementations

G. Diabetes management

Diabetes mellitus is a lifelong, chronic condition that is characterised by the body's inability to control glucose levels in the blood [7].

Diabetes affects about 22.5 million adults in the European Region and is increasing rapidly in most countries. Moreover, it has changed from affecting mainly older people to also afflicting people in the first half of their lives [8].

Recent projections, based on the assumption of a stable obesity rate, foresee that at least about 26 million citizens in Europe (about 6 per cent of the population) will be affected by diabetes in the EU by 2030 [8].

Monitoring of blood glucose is an integral part of treating diabetes as it supplies essential information to the health care personnel to adjust the therapy [7].

Self-monitoring of blood glucose gives the patient the possibility of immediately seeing the effects of certain activities, foods and drinks on glucose level [7].

Near-patient blood glucose measuring devices are becoming more and more common. The Health Gateway mobile solution is able to collect blood glucose measurements directly from the measuring devices and seamlessly transfer the collected data to the health care personnel for further analysis.

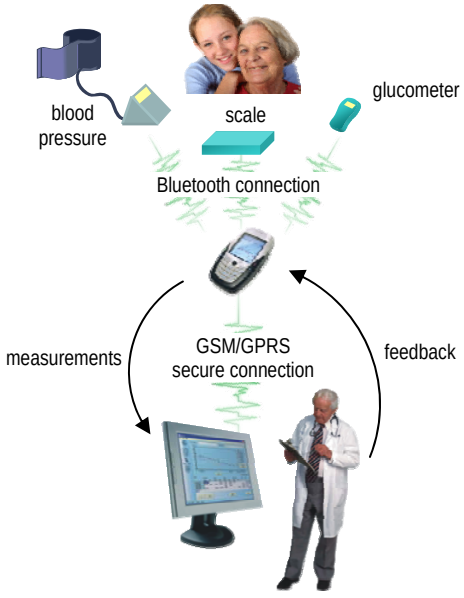
Several measuring devices are capable of storing measured values in their internal memory. This information can be easily transferred to the patient mobile device via Bluetooth, Infrared or cable connection according to the type of measuring device.

The patients then have the possibility to browse the results from a list or to have them displayed in a clear graphical follow-up form directly on the display of their mobile device. This gives the patient an immediate overview of his/her blood glucose behaviour. Results are also immediately forwarded by GPRS/GSM/3G to the clinic where they are available for analysis to the health care professionals.

In addition to collecting information from the glucometer, the same Health Gateway mobile device can wirelessly collect measurements also from an electronic scale and a blood pressure monitor.

This additional weight and blood pressure monitoring helps in giving the health care personnel a more complete picture of the condition of the patient.

Figure 4. Use of Health Gateway in Diabetes management



All of this information is linked together and sent to the health care professionals, which after analysis or consultation can send a feedback to the patient.

Therefore, in addition to instantly viewing their progresses on the mobile device display, patients can also receive information from the caring personal regarding for instance changes to the treatment, diet or exercise program.

H. Blood coagulation monitoring

Oral anticoagulation therapy (OAT) is necessary for people carrying an artificial heart valve, or affected by atrial fibrillation or thrombotic diseases. The correct dosage of anticoagulant is crucial for the patient health. People may react differently to the therapy and other drugs but also food and drinks may alter the effect of the anticoagulant. Regular monitoring of coagulation is therefore essential [9].

Traditionally, monitoring of coagulation (INR values) requires a blood sample being drawn from a vein and analysed by health care professionals. This is a time consuming operation and it usually requires the patient to travel to a health care centre or doctor's office.

Today the advantages of self-monitoring have also reached coagulation monitoring. This gives the patient many advantages: it is straightforward, it makes routine testing easier, it gives independence back and it also means patients can be directly involved in their own health care, in collaboration with health care professionals [9].

An additional service can be offered by using the Health Gateway platform. As the mobile device receives the measurement data from the coagulation meter, the program may calculate the suggested new value of the anticoagulant medication automatically.

Furthermore, the measured values and the calculated medication values are transferred to the health care professionals, which can then send a feedback to the patient's mobile device.

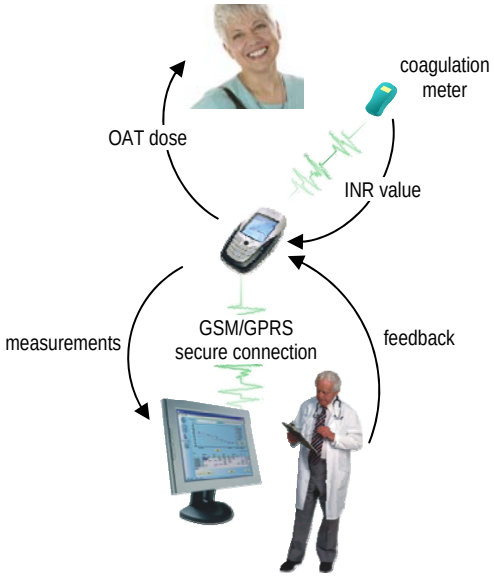


Figure 5. Use of Health Gateway in Blood Coagulation Monitoring

I. Incontinence treatment

Stress urinary incontinence is mainly a reflection of decreased pelvic floor muscle control. Urinary incontinence has a number of causes and conventional treatment may sometimes be ineffective. In severe cases surgical intervention may be needed [10].

Preventive training of the pelvic floor muscles before pregnancy and/or after childbirth improves the situation significantly, especially if the training can be done at home and progress is monitored by a health care professional. The condition and the activity of the pelvic floor muscles can be detected and measured using electromyography (EMG) [10].

The unique FemiScan™ concept by Mega Electronics Ltd facilitates both subjective and objective follow up of the patient's progress towards continence while in the clinic and at home. The system consists of a vaginal electrode, and a battery operated training device equipped with headphones. The device guides the patient in the daily performance of the pelvic floor muscle exercises. The instructions for the treatment can be created individually for every patient and programmed in her own home treatment device. The patient will hear a voice-controlled training program by head phones in her own mother language. She will get clearly worded feedback of every contraction / relaxation session immediately.

Health Gateway makes the incontinence treatment even easier. The FemiScan™ Multi Trainer automatically keeps a daily record of the treatment, which can be transferred to the clinic by using Health Gateway mobile solution. The information is wirelessly transferred from the FemiScan™ Multi Trainer to the patient mobile device and forwarded by GPRS/GSM/3G to the clinic where the data are analysed in graphic form using the FemiScan™ software.

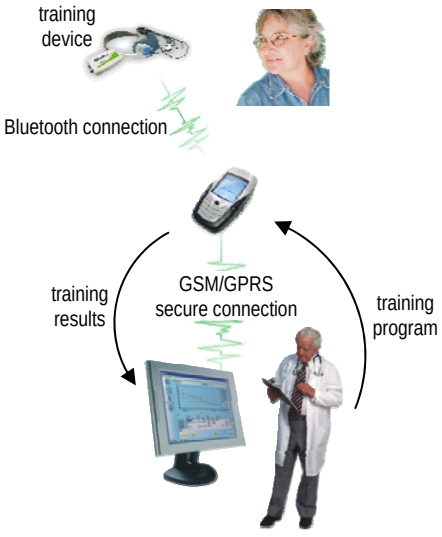


Figure 6. Use of Health Gateway in Incontinence Treatment

According to the results, the caring personnel may decide to make some changes to the training program. The bidirectional capability of Health Gateway makes also possible a remote update of the instructions for the treatment.

The new training program is transferred from the clinic to the user mobile device by GPRS/GSM/3G and wirelessly uploaded to the training device. In the same way, the patient can also receive fast feedback from the physician/nurse directly to the display of her mobile device.

FemiScan™ concept gives the patient the possibility of performing her training session at home in a private environment. Health Gateway brings this concept further, allowing the patient to exchange information with the caring personnel and even to update the training program, without the need of travelling to the clinic.

VI. Conclusions

Point of care testing is growing rapidly in terms of technology advancements and healthcare economics. The combination of self-monitoring devices with mobile technology presents several advantages in comparison with traditional methods: measurement results are accurate, available in real-time and in correct form; faster patient treatment process – patient can receive feedback almost immediately; motivating treatment progress information directly available to the patient; evidence based process traceability information: remote measurement and monitoring regardless of patient location; easy to use for both patient and nursing staff. Health Gateway platform offers a complete mobile solution, which brings point-of-care flexibility a step further.

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Session 4

Tele-Education: A Must for Success

Tele-Education in Russia: Support Reform and Development of the Health Delivery System

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Abstract- The Russian Federation is in transition period to international principles of health care delivery shifting the focus to primary health care (PHC). Strengthening PHC requires qualified medical staff including general practice doctors and nurses. Training of medical staff should be based on long-term planning and result from strategic needs. In this respect, the scientifically-justified method of determination of long-term needs of the health sector in staff will be developed and implemented. We are sure that our real experience in tele-education applications with majority of Russian regions (towns and villages, maximum distance – 12.000 km) will be a good support for PHC Federal Program in training and retraining of health personnel. By now we have three levels All-Russian videoconference network with more than sixty telemedicine points in rural and remote districts of the country. Each telemedicine point usually is placed in regional or district hospital and has the art video conferencing system and ISDN or IP channels (or both) and sometimes Space Satellite channel. We suppose that telemedicine points in district hospitals (third level of network) will be the base for organization tele-educational support for doctors of general practice and the nurses. Advantages of tele-education: saving of money, possibility of working with a number of telemedicine points in the same time, chance to attract unique scientists for the tele-education, way to show unique operations and methods of diagnosis, combination of lecture and clinical discussion, the process of training doesn't interrupt the work general practice doctors and nurses in there Health Center in Russia's rural and remote villages and will save a lot of money (very frequently such doctor is all alone in a large district). It should be noted that the basis for the development of tele-education throughout the rural and remote districts of the country is the understanding of economic efficiency of information technologies for cutting the costs associated with training process of each doctor. Our research has shown that tele-education's centers are economically feasible. The main result of the research was the fact that telemedicine education and consultations centers in small cities and villages are a good return on small investments. For the local population such a centre provides an access to the world leading specialists, while the expenses of the individuals needing such studies and individual consultations are significantly lower than the ones they have to incur for travelling to a training center or clinic. Our colleagues from the Central Siberia assert that, each telelection for specialist from remote village is forty times cheaper than the same one in regional training center. Our experience shows that new multy-points videoconference information technologies open for us modern ways for professional contacts: teleschools, teleseminars, telesymposiums. This is very important when physician's Health Center in Russia's rural and remote village gets new modern diagnostic units (for example: Digital stethoscope, Blood Pressure Measuring Device, Weight Meter, Glucose Meter, Blood Oxygen Saturation Level (SpO2) and Respiratory Flow Meter up to ElectrocardioMeters, EchocardioMeters, Ultrasound digital equipment and so on) – in any case tele-training is only way for quick installation and makes physician familiar with it.

Keywords: telemedicine network, remote regions, interactive tele-training, PHC.

Ophthalmic Post-Graduate Teaching in Ireland: The Experience using Video-Conferencing and Collaborative Technologies

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Abstract- The paper describes the experience during the last two years in expanding the regional reach of the Seminar Series of the Ophthalmic Post-graduate Teaching Programme operated by the Royal Victoria Eye & Ear Hospital (RVEEH) centrally located in Dublin, the capital city of Ireland, through the use of high quality audio and video-conferencing and collaborative technologies. The paper outlines the approach taken in developing an Information and Communications Technologies (ICT) enabled model of instruction, to meet the pedagogical needs of (i) the programme administrators, (ii) the presenters of both clinical cases and specialist topics and of (iii) the medical participants. The initial testing and validation of the pedagogy and technology commenced in late 2003 between the national Health Services Executive (HSE) facilities in Dublin and Sligo General Hospital some 220 kilometres away in the north-west region of the country. The region had an infrastructure and skills for piloting innovative telehealthcare systems which was drawn upon. The participants were surveyed after the initial seminars and high satisfaction ratings were achieved. Following successful experiences further regional sites namely, the Letterkenny General Hospital and the University College Hospital Galway, were added in turn. The educational and technical experiences were again reconfirmed by a 2005 year-end survey. Technical testing, guidelines and dry-runs for presenters are an established feature of pre-seminar activity. Being a teaching programme there is a changing stream of medical specialists to speak and a periodic turnover of junior doctors that present their clinical cases. Twin screens are used at each location to separately and adequately display (i) the continuous audio-visual (A-V) of the speakers and (ii) the data/teaching materials. From a technical perspective, the inclusion of high quality clinical ophthalmic content (still images and digital video) presented a particular challenge. Several different methods for transferring and synchronously sharing lecture materials were progressively evaluated before satisfactory collaborative software was found. The A-V technology employed is based on high quality audio (G.722) and video (H.263) using an Integrated Services on a Digital Network (ISDN) connection (384 kilobits/second). The success achieved has resulted in emphatic requests for participation from more regional hospitals. Recent activity includes preparation of additional sites with sponsored access to a Virtual Private Network (VPN) with 12-way video-bridging facilities handling the mixed Internet Protocol (IP) VPN and ISDN connectivity capabilities to 2 megabits/second. The paper includes treatment of the pedagogical, technical, procedural and other experiences, the results achieved and the conclusions drawn from the service development to date.

I. INTRODUCTION

This paper describes the experience during the last two years in expanding the regional reach of the Seminar Series of the Ophthalmic Post-graduate Teaching Programme operated by the Royal Victoria Eye & Ear Hospital (RVEEH) centrally located in Dublin, the capital city of Ireland, through the use of high quality audio and video-conferencing and collaborative technologies.

Figure 1 illustrates the geographical spread of the video-conferencing network service as it is currently operated with three regional links each a distance of over 200 Km. from the Dublin hub.

The Sections below describe the evolution of the service and the experiences to date. Sections II & III respectively describe the background to the service and the key demand of regional training needs. Section IV states the aims of the service that extends the regional reach of the Ophthalmic Seminars. The profile of the seminars is laid out in Section V. The factors influencing the design and its main underpinning criteria are identified in Section VI. Section VII addresses the phased implementation strategy and is followed by Section VIII which outlines the pedagogical outcomes to date. The main technological components and their evolution through the period is provided in Section IX before the actual technical experiences and issues are summarised in Section

X. Procedural issues are briefly touched on in Section XI, before service development possibilities, are treated in Section XII. The main conclusions are summarised in Section XIII.

II. BACKGROUND

The RVEEH or the 'Eye & Ear' as it is popularly known, is a third level specialist teaching hospital in the Dublin region that among its main activities, is recognised nationally and internationally for its Post-Graduate Teaching Programme in Ophthalmology.

The genesis of the initiative for the video-conferencing teaching service emerged from the innovative undertakings in tele-education and telemedicine services emerging in the northwest of Ireland [1] and the establishment of a state-of-the-art video-conferencing facility directly adjacent to the Eye & Ear Hospital in Dublin. These developments fortuitously coincided with discussions for participation between the Sligo General Hospital (SGH) Ophthalmic Dept. and the Programme Co-ordinators at the Eye & Ear Hospital.

The northwest region of Ireland is geographically remote from Dublin and lacks a quality transportation infrastructure to readily access the capital city.

Figure 1. The Video-Conferencing Network for the Ophthalmic Seminars.

III. REGIONAL TRAINING NEEDS

Regional hospitals are generally acknowledged to be at a disadvantage to their urban counterparts in recruiting and retaining highly qualified medical staff. Thus access to and participation in continuing medical education (CME) and specialist teaching programmes conducted in Dublin, such as, the Eye & Ear Ophthalmic Seminars, is highly valued by both the regional hospitals and their medical personnel.

The geographic location of the regional hospitals makes regular physical attendance impractical. Added factors, such as the European Working Time Directive for doctors in training, has placed a sharper focus on the potential for innovative technology-based solutions to provide acceptable solutions.

IV. AIMS

The main aim of the video-conferencing based service was to extend the practical and operational reach of the high quality teaching in the Seminar Programme to meet the needs of the regionally based post-graduate ophthalmic trainees. From the programme administrators' perspective, the aim was to ensure that the effectiveness of 'virtual participation' in the technology-enabled model of instruction would be as close as possible to that of physically attending participants.

The undertaking was one that was to draw upon 'best practice' in tele-training and in technological options as far as the existing facilities and resources permitted and in itself was not structured and resourced as a research activity.

V. OPHTHALMIC SEMINARS

As an integral part of the Post-Graduate Teaching Programme, Ophthalmic Seminars of 1.5 to 2.0 hours duration are held on a regular weekly basis throughout the academic year.

The seminars address key topics within ophthalmology. Typically they comprise of two sections (i) Clinical Cases and (ii) a Main Topic. The clinical case presentations are delivered by the trainee doctors and they involve questions and answers (Q & A) sessions conducted with their supervising senior consultant. The main speaker is an established expert specialist who often comes from an overseas hospital or centre of excellence. Again, the format is generally one of a presentation with/without interactivity and followed by a generous Q & A period.

The verbal presentations are almost uniformly aided by illustrative teaching content, typically electronic slides (ex Powerpoint). The slides almost always contain high quality ophthalmic still images and in more recent times, digital video clips from camcorders and DVD sources (Digital Versatile/Video Disc) are an emerging media component.

An inherent feature of the annual programme is the continual turnover in seminar presenters, both junior doctors and specialists. This provided an on-going challenge to pre-seminar preparations. The number of attendees at the Dublin location was typically thirty to forty while the regional participation adds approximately another twenty to that number.

VI. DESIGN CONCEPT & CRITERIA

The design concept reflected the pedagogical aim to make the virtual participation as rich as a real presence in the presenting location. Current technologies fall short in realising this ideal outcome. While the conferencing and tele-presence industry have made significant strides in the past

two decades there is considerable distance to go in this regard as well as in the research and understanding of human communication and pedagogical processes.

The design criteria for developing the tele-pedagogical model are important derivatives from analyzing a mix of factors including (i) the needs and profile of the seminars, (ii) existing best practice guidelines and research findings, (iii) the actual available conferencing facilities and constraints (iv) technical equipment, software, standards, networking considerations and emerging trends. These included:

a) high quality audio at all sites for speakers and Q &A
b) high quality video-conferencing
c) teaching content slides/ high resolution ophthalmic still and video images to be available without degradation at all sites
d) dual or separate links for (i) audio-visual (A-V) and (ii) content /data
e) life-size speaker display at far-end sites
f) continuous viewing of all sites at all sites
g) simultaneous display of content with clear legibility for local participant numbers (on a large separate screen)
h) effective speaker/participant eye-contact for all sites
i) pre-conference availability of content
j) pre-conference dry-run sessions and basic e-skill briefings for all first-time presenters
k) routine pre-conference technical testing of connectivity, the format and other requirements
l) easy-to-use conference moderator controls and
m) reference guides for local support, co-ordinators, speakers and non-technical users of the conferencing /collaborative system.
n) contingency measures in place through prior content file transfers and alternative audio-conferencing arrangements

VII. PROGRESSIVE IMPLEMENTATION

A phased strategy was adopted to keep the technical and logistical issues on a manageable scale. The initial testing and validation of both the technology and the pedagogy commenced in September 2003 between the Dublin and Sligo conferencing facilities as a single point-to-point (1:1) conference as illustrated in Figure 2.

Figure 2. The Initial Dublin – Sligo Video-Conferencing Seminar Link.

This approach permitted the support and co-ordinating personnel to gain the necessary skills. It allowed the initial speakers to be pre-tutored in tele-training skills with dry-runs with video-conferencing links and for their content to be prepared, quality checked and distributed in advance. Importantly, it ensured consistent successful participant experiences in the live seminar sessions. The seminars started on a monthly basis and this frequency has continued since that time. The participants were surveyed after the first four seminars and high satisfaction ratings were achieved in respect of the quality of the training and the quality audio and video technology.

The second regional site of Letterkenny General Hospital was added in January 2004 and the University College Hospital (UCH) Galway joined in from late that year. This combination of sites has continued through 2005 and to the current time.

Figure 3 show the matrix pattern of all site display that is continuously present at all sites. This has proved popular and allows for easier interaction between participants at different locations. The normal practice in Q & A was to first seek questions from the virtual participants at regional sites to ensure their engagement in the teaching process.

Figure 3. The Continuous Presence Matrix of all Sites that is Displayed at All Locations.

The separate and simultaneous displays of video martix of participants and of the teaching content is illustrated in Figure 4. The screen on the right shows the digital video clip of the eye surgery whilst the three regional sites along with the Eye & Ear site with the speaker are projected onto the left screen.

VIII. PEDAGOGICAL OUTCOMES TO DATE

The learning experiences to date have continued to be universally held in high regard by visiting speakers as well as the participating doctors. This has equally been the judgement of the Programme Co-ordinators and has been further confirmed the by the keen interest of other regional hospitals to participate.

Presentations from the regions have also been successfully integrated into the programme. A second survey conducted at the end of 2005 also provided a satisfactory pedagogical rating.

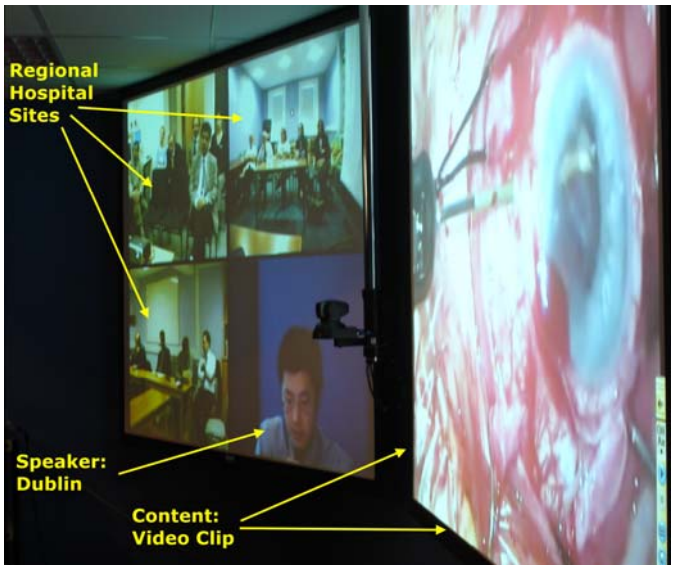

Figure 4. The Dual Simultaneous Display of the All Site Videos (Left Screen) and the Teaching Content (Right screen).

Throughout the period the underpinning technology and procedures continued to evolve bringing several benefits to the operation of the programme. Inherent limitations of the existing technical facilities have constrained the expansion of the locations in the short term.

IX. MAIN TECHNOLOGICAL COMPONENTS

The two major components in the seminar conferencing model are (i) the audio-visual link and (ii) the data/content display link. The audio-visual link together with a separate synchronized data/content display provides a richer communications environment for the far-end sites and a closer replication to physical attendance. In effect it is a dual conferencing model.

Within the first component, audio was recognised as the most important channel for professional seminar delivery and interaction, where a high quality standard was deemed essential. The International Telecommunications Union, Tele-communications sector (ITU-T) co-ordinates standardization for tele-conferencing industry. The G.722 level was adopted as the entry level for the seminars, as it provided higher (7kHz) than telephony quality in a 64kb/s channel. Similarly, quality video represented by the H.263 standard at the time of commencement of the service was adopted as the minimum requirement for seminar sessions, together with a network connection bandwidth of 384kb/s. This equated to the use of three lines of an integrated services digital network (ISDN) or ISDN-6. The A-V combination proved adequate to provide high quality communications with solid lip-synchronisation, negligible latency to impede interactive real-time discussions and negligible picture artifacts in the low movement environment of seminar delivery.

Possibilities for internet protocol (IP) network connectivity were non-existent at commencement date for the locations involved. The reliability of ISDN proved satisfactory and the call tariffs also reduced over the period. The user evaluation of the initial test links confirmed the quality levels of the audio-visual conferencing to be very satisfactory.

In expanding to the additional sites the technical inter-operability and the minimum standards were important audit points in determining eligibility. The internal 'bridge' or multi-point control unit (MCU) at the Dublin hub allowed for three external connections (1+3 sites). The bandwidth was maintained at 384kb/s to each site, as a primary rate (PR-ISDN or ISDN-30) connection was in place at the hub.

With the second major component, adopting a separate link for data, had distinct advantages, though it meant a non-integrated model. This turned out to be an area of significant challenge and progressive change to the conferencing seminars.

The content essentially needed a one-way distribution stream, rather than an interactive or two-way communication. So transmission latency of less than 100 milliseconds was not critical to good communications. Indeed one to two seconds would be tolerable provided the integrity of the stream was maintained. It allowed separate simultaneous display without degradation which was a key design criterion. Scan conversion of computer-based digital files, such as Powerpoint, into analogue video signals for transmission generally means serious degradation of text and ophthalmic image quality and was not entertained.

Prior to dual-stream transmission being standardized (H.239) it required to sacrifice the video-stream of the speaker, effectively downgrading the video-conference into a data and audio-conferencing mode. H.239 dual streaming came too late for the established site facilities and requires hardware upgrade and fresh capital investments. Dual-stream video and data, as a proprietary protocol, was trialed in the test phase between same manufacturer equipment. This achieved real-time synchronization of the slides without the need for the far site to be aurally cued. It did not suffice as an adequate solution in the later multi-vendor environment and so was abandoned.

Thus emails with content files as attachments were initially the norm for content distribution. Content display was always achievable through local laptop or computers with full integrity. With increasing concerns of hospital computer system infection through email attachments and the introduction of more stringent firewall policies this method became unreliable. Content distribution was next achieved by switching to file transfer protocol (FTP) approach with user ID and password requirements for access. This method remains in place and is very satisfactory. It has been enhanced to allow overseas and national speakers to upload the content in advance via their Internet browser. In turn this has eliminated the need for speakers mailing compact discs (CD) containing their lecture media.

A significant investigation and monitoring of the various emerging software solutions that offered web-based collaboration was undertaken over the last eighteen months.

This uncovered in excess of 15 products and services, which were reviewed and a number tested outside of the live seminar setting before one was adopted. Collaborative software has in that period become a burgeoning area of innovation and growth as it has overcome the limitations of earlier non-browser based products.

The adopted web-based collaborative component is simple for speakers to use. Far-end participant screens are auto-synchronised to that of the presenter's computer. This occurs with low latency and without the degradation in the quality of text and ophthalmic images. The presenter's mouse movements and annotation, as well as limited slide animations, were also replicated at all sites. Email invitations to join the data meeting are pre-sent to the regional site co-ordinators with simple 'click-to-join' the relevant web address. However, none of the products reviewed to date can handle the demands of digital video with current IP connectivity. The FTP approach is used in these circumstances allow sites play the video clips where the original quality is essential.

X. TECHNICAL OUTCOMES TO DATE

The above technical components served to deliver a high quality technological underpinning for the Ophthalmic seminars. The second survey of participants conducted in December 2005 confirmed the satisfaction rating.

XI. PROCEDURAL EXPERIENCES

Procedural aspects apply to administrative, ICT support and participant/speaker aspects of the service. Both the training the individuals involved and the development of procedures were found to be important to (i) pre-conference planning (ii) in-conference activities, and (iii) post-conference follow-up. Several reference guidelines were prepared. Pre-conference testing and dry-runs were a regular feature throughout.

XII. SERVICE DEVELOPMENT POSSIBILITIES

Keen demand has been expressed from several more regional hospitals to join in the ophthalmic seminar series. This is a matter of importance to the Ophthalmic Teaching Programme Co-ordinators. A major consideration is the maintenance of the quality of the existing educational experiences. However, a solid foundation of experience has been laid over the last two to three years on which to evaluate and resource future moves.

Regional hospitals are increasingly using video-conferencing for CME, continuing nursing education (CNE), administrative applications as well as telehealth services. Planning the future use at regional sites also needs to integrate the requirements of several medical specialties in addition to ophthalmology. While no economic analysis has been encompassed in the current service, tele-educaton evaluations particularly in CME situations have proved positive returns on investment [2], [3].

The service management is acutely aware of the current global trend towards IP-based networks and unified voice, video, data, mobile and presence communications services provision and the promise of simplification and virtualization that it offers. Currently, public tenders are out that will result in the establishment of a national health network with broadband capability between major hospitals nationwide and within the greater Dublin area.

In addition, a sponsored virtual private network (IP VPN) was made available to the service over the past six month. This involved connectivity at 2Mb/s and 12-way bridging for IP and ISDN calls. Tests were conducted to assess the performance under various conditions. It provided the opportunity to conduct one of the live sessions through the bridge with mixed IP and ISDN connectivity. This further experience will be integrated into forward planning.

Similarly, recent industry developments have seen continuing strides in higher CD quality audio (14-20kHz), new firewall transversal standards, new video quality H.264 and high definition (HD) video-conferencing systems, larger and more widescreen displays with variable layout options, higher capacity internal MCU's and more powerful external bridges, to name but a few.

The ophthalmic teaching service is open to innovations that can better and more effectively meet its needs.

XIII. CONCLUSIONS

The conclusions from the experience of the Ophthalmic Post-Graduate Teaching in Ireland with video-conferencing and collaborative technologies are that it:

(1) successfully provided regional access to CME
(2) enhanced the quality of the programme itself
(3) created the potential for a national network
(4) gave precedence for other medical specialities
(5) showed that success in video-conferencing comes from taking a quality route to ensure positive outcomes –namely, going 1st class.

ACKNOWLEDGMENTS

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The six month sponsorship of Network-ie Ltd. for the IP VPN network access in Sligo and Dublin and multi-point bridge facility is also hereby acknowledged.

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New Telemedicine Approach to Routine Sports Medicine Practicing with Mobile Tools

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Abstract- Physiological endurance testing remains the one of most important tasks for Sports Medicine. Those tests remain crucial for sportsmen, coaches, physiologists and sports medicine specialists. Regular exercises may improve biologic age of active person but also decrease significantly the risk of hart, metabolic or musculoskeletal disorders. Regular exercise attraction serves as an integral part of either prophylaxis or rehabilitation. The most indicated forms of physical activity are walking, jogging, swimming, cycling, rowing or long distance skiing. Walking or jogging does not require too much specialized training or skills. Many tests were developed for aerobic endurance evaluation during simple activities. Most of them are age independent. Part of those tests does not require specialized equipment and laboratory environment. Currently mobile phone with specialized software may serve instead of simple equipment required for such testing. Mobile phones are used now not only for communication, but often for replacement of other electronic devices for work and entertainment. Most of all manufactured phones are designed to create and run software written in Java. That makes easier to extend mobile phones functionality. PulseTester seems to be the first application developed for mobile phone, allowing simple physiological tests performance without other additional equipment. Results could be stored in the phone's memory or send via GPRS and stored on special server for further retrieval and analysis. An application was implemented in J2ME technology. It may operate on almost all mobile phones with implemented Java. The presented application may serve for sportsmen evaluation but equally for elderly and disabled. Transmission via GPRS and storage of data on server opens the possibility of physical ability monitoring.

Key words: Physical endurance testing, mobile phone, application, monitoring

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Dissemination and evaluation tools for eHealth products, services and distance education

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Abstract-Two evaluation and dissemination tools are described to provide technical support to Member States in relation to eHealth products and services by disseminating widely experiences and best practices and evaluating the knowledge of students in e-health distance education. The first tool is the evaluation system ExaMe focused on the use in distance education. The first version of the ExaME system was applied in frame of the European project IT EDUCTRA concerning the use of information technologies in education and training in 1998-2000. The service ability of the ExaMe evaluation system as the supporting evaluation tool has been repeatedly shown at the courses of Ph.D. studies in Biomedical Informatics at Charles University in Prague. The second version of the system ExaMe was developed in the period 2001-2002, presented at the International Joint Meeting EuroMISE 2004. The third version was developed with the support of the ESF project no. CZ.04.3.07/4.2.01.1/0013 coordinated by MEDTEL o.p.s. The second tool is the new European Journal of Biomedical Informatics (EJBI) that is reacting on the great European need to share the information in the multilingual and multicultural European area. EJBI (http://www.ejbi.org/) opens for the field of biomedical informatics a new model of electronic publishing. EJBI is publishing peer-reviewed papers submitted in English with their other European languages versions simultaneously. This opens new possibilities for faster transfer of scientific-research pieces of knowledge of many European countries to a large international community of biomedical researchers, physicians, other health personnel and citizens. Moreover, the journal now enables to make results of scientific-research work and practical experiences of foreign specialists accessible to wider health public in a more comprehensible way in each European country.

I. INTRODUCTION

Training and education in medical informatics, statistics and epidemiology provided by the EuroMISE Centre have originated in the joint European project titled „Education in the Methodology Field of Health Care“of the Tempus –Phare program running in the years 1993-1995. The teaching scheme has been developed in cooperation among eleven EU universities, Charles University in Prague and Institute of Computer Science of the Academy of Sciences of the Czech Republic [1], [2]. The EuroMISE guidelines place considerable emphasis on the need for a wide range of knowledge, including a thorough understanding of health concepts [3], [4], [5], [6]. Moreover, education and training in this field have supported to bridge the gap between technological innovation and health care practice. European experience using new information technologies in education and training was described in [7], where also the experience with the EuroMISE courses running in the years 1993-1995 was given and in [8]. Since 1998 the system ExaMe for evaluation of a targeted knowledge is being developed [9]. The idea of the system is based on multiple-choice questions, but with no prior restrictions on the number of selected answers. The only restriction is that at least one answer is correct and at least one wrong. This new idea has led to new concepts of standardization of test results and many new theoretical developments. The evaluation system ExaMe is an important part of education and training at the EuroMISE Center. The ubiquity of the Internet and its World Wide Web applications made it possible to realize the new educational goals in innovative and creative way.

The International Medical Informatics Association (IMIA) agreed on international recommendations in medical/health informatics education. The IMIA recommendations centre on educational needs for health care professionals to acquire knowledge and skills in information processing and information and communication technology. The educational needs are described as a three-dimensional framework. The dimensions are:

- professionals in health care (physicians, nurses, HMI professionals, ...),
- type of specialization in health and medical informatics (IT users, HMI specialists) and
- stage of career progression (bachelor, master, ...).

The recommendations were develop by the IMIA Working Group 1: Health and Medical Informatics Education and published in “Methods of Information in Medicine” in 2000 [10]. These recommendations have been translated in several

other languages. Original document is available at http://www.imia.org/. Czech translation was published in the Czech journal "Physician and Technology" in 2001 [11]. Recommendations are given for different types of courses/course tracks of educational programs in medicine, nursing, health care management, dentistry, pharmacy, public health, health record administration, and informatics/computer science as well as for dedicated programs with bachelor, master or doctor degree.

In the next section we give more details about two dissemination and evaluation tools for eHealth products, services and distance education.

II. EXAME SYSTEM

The first tools is the ExaMe system. First version of the ExaME system was developed and applied in frame of the European project IT EDUCTRA (http://www.cordis.lu) in the period 1998-2000. The service ability of the ExaMe evaluation system as the supporting evaluation tool has been repeatedly shown at the courses of Ph.D. studies in Biomedical Informatics at Charles University in Prague (12). The second version of the system ExaMe was developed in the period 2001-2002, presented at the International Joint Meeting EuroMISE 2004, in Prague, Czech Republic and some features described in details in (13). The third version was developed with the support of the ESF project CZ.04.3.07/4.2.01.1/0013 eHealth Promotion Network running in 2005-2007 coordinated by MEDTEL o.p.s. ExaMe system has opened new possibilities for self-evaluation in distance education, in courses that are under development in frame of the project for Ph.D. students, physicians, health managers and other health personnel. The impact of the ExaMe system is strengthen when the system is joined with electronic books or other electronic educational materials on Internet.

Now the ExaME system is applied as a supporting evaluation tool at courses of Ph.D. studies for students of Charles University in Prague, Technical University in Prague, physicians, health managers and other health personnel.

A. *The Evaluation by the ExaMe System*

The evaluation by the system ExaMe is based on the knowledge base created for a specified target, mostly for knowledge covered by a special course. The knowledge base consists of generalized multiple-choice questions (number of answers is not limited, at least one answer is true and at least one false). For each question, scores define its importance and difficulty. The importance is given in five categories (very important, important, moderately important, little important, not important). Similarly, the difficulty is given in five categories (very easy, easy, standard, difficult, very difficult). For each answer, its weight is defined. The weight is given by number of points (integers) from the range –5 to +5, except 0. Weights should be positive for true answers and negative for false answers. Moreover, explanations of true or false answers are formulated.

When student answers the question (by marking the correct answers), the system calculates the standardized score for the question (in the range –1 and 1), using the weights of the offered answers. After student answers the whole test, the total standardized score (also in the range –1 and 1) is computed by the system, using the standardized scores for each question and questions' importance. A student should not pass the exam unless his/her total standardized score is higher than zero.

B. *The New Three-Layer Architecture*

Nowadays, the system ExaME works at three levels. The first level is a supervisor level, where a supervisor (e.g. group of teachers, defined body) creates generalized multiple-choice questions for a given target, marks true and false answers and formulates explanations. The nowadays implemented knowledge bases cover the targeted knowledge of corresponding courses based on Czech electronic books on Internet (http://www.euromise.cz) and other electronic educational materials.

The second level is a specification level. In this level, the questions' importance and difficulty and answers' weight for a knowledge base are specified. For example, a different specification can be used in evaluation of medical informatics knowledge for medical students and students of informatics. Automated tests can be created from any knowledge base with specification. The system allows creation of a multiple knowledge bases with specification from one knowledge base without specification.

The third level is a teacher level. A teacher can create a fixed test from a knowledge base with specification and make evaluation for her/his needs, see Figure 1.

Figure 1: Fixed test edited by a teacher

C. *Fixed and Automated Tests*

From the knowledge bases, two types of tests may be created: the automated and the fixed test. The fixed test is appropriate for evaluation of the group of students in computer classroom connected to Internet. In the third (teacher) level of the ExaMe system the fixed test can be easily created by a teacher simply by choosing appropriate questions and answers from a specified knowledge base.

The automated test is appropriate for self-evaluation on remote places. The student can ask for evaluation by an automated test on chosen topics and with chosen overall difficulty. Afterwards, the test is generated immediately by the system out of appropriate specified knowledge base. Students can pass evaluations by automated tests by themselfs and the final results of the tests are displayed immediately. The wrong answers are marked in the red color and the explanation, why the answer is wrong appears, see Figure 2.

Figure 2. Results of the automated test

D. Objectives - Reliability of the Fixed Tests in the ExaMe

Besides developing the system itself, our next goal is to suggest and to research the statistical tools for analyzing the quality of a fixed test and quality of its items. We attempt to suggest the tools, which would help the teacher to create a fixed test optimal for the needs of his/her course.

During the last decades the reliability of educational tests has often been examined. In connection with reliability, the characteristics for its estimation, such as Cronbach's Alpha, has often been mentioned. To fulfill our goal, in the first part of our research we have critically examined the statistical background of the reliability and of characteristics used for its estimation. We have investigated the relationship between these characteristics and reliability and between characteristics themselves. Shortcomings and limitations of the theory are discussed in this article. We have also implemented the researched estimates of reliability into the ExaMe system.

E. Main Benefits of the ExaMe System

A quick administration of knowledge evaluation is the main strength of the ExaMe system. From the knowledge base with specified importance of questions and weights of answers, it is very fast and easy for a teacher to prepare a test optimal for his/her special group of students. After student answers the whole test, the system automatically evaluates the test and a teacher can print for each student a corrected test, where the mistakes are highlighted, explanations of correct answers are given, and standardized score for each question and the total standardized score are computed.

ExaMe system is also a modern tool for self-evaluation and self-study. Besides the correction of automatically generated test, system gives suggestions, which subject matters should be studied more deeply, and offers links to the electronic textbooks.

III. EUROPEAN JOURNAL OF BIOMEDICAL INFORMATICS

The second tool is the new European Journal of Biomedical Informatics (EJBI) that is reacting on the great European need to share the electronic information in the multilingual and multicultural European area.

EJBI (http://www.ejbi.org/) opens for the field of biomedical informatics a new model of electronic publishing. EJBI is publishing peer-reviewed papers submitted in English with their other European languages versions simultaneously. The first issue of EJBI was published in November 2005, see Figure 3.

Figure 3: Articles catalog in the first issue of EJBI

EJBI opens new possibilities for faster transfer of scientific-research pieces of knowledge of many European countries to a large international community of biomedical researchers, physicians, other health personnel and citizens. Moreover, the journal now enables to make results of scientific-research work and practical experiences of foreign specialists accessible to wider health public in a more comprehensible way in each European country.

The aim of the editorial board is to reach the highest scientific level of the journal and show the best practices of biomedical informatics applications to wide readership. The European editorial board is composed from well/known specialists in the field of biomedical informatics. We believe that their activities for EJBI will contribute to propagation of journal's good credit. The editorial board also presumes that presentation of English versions of scientific papers with their professional translations to other languages will significantly

contribute to unification of applied scientific terminology in European languages.

The first issue of the journal covers six papers in English with their national versions in Bosnian, Bulgarian, Czech, Greek, Romanian, and Spanish languages. Therefore we can display the papers in English and translated national versions of the paper simultaneously. We can see for example Greek version of the paper, see Figure 4

Figure 4: Greek version of the full paper in EJBI

and English version of the paper, see Figure 5.

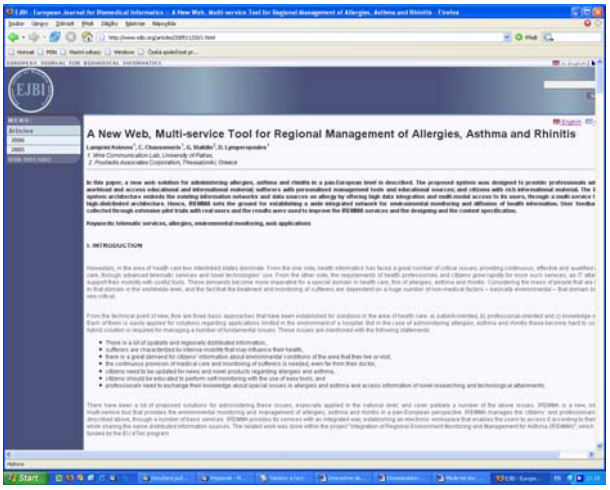

Figure 5: English version of the full paper in EJBI

Biomedical informatics is a burgeoning field, with important applications and implications throughout the biomedical world and healthcare delivery. The European Journal of Biomedical Informatics (EJBI) is reacting on the great European need to share the information in the multilingual and multicultural European area. We sincerely hope that the EJBI will provide an international medium for dissemination of original results, interpretative reviews, applications in biomedicine and health care and other types of communications concerning the field of biomedical informatics.

IV. CONCLUSIONS

The serviceability of the ExaMe evaluation system as the supporting evaluation tool has been repeatedly shown since 2000. The system offers a quick and convenient administration of evaluation of group of students. The ExaMe system also opens new possibilities for self-evaluation and distance learning, especially when connected with electronic books on Internet.

In the last years, the reliability of educational test and its estimation using Cronbach's alpha was (at least in the Czech Republic) given more interest than the strength of this tool deserves. In this article we have discussed some shortcoming and limitations of the reliability. When using the tools for estimations of the reliability, we should keep these limitations in mind. Nevertheless when understanding the theory background, the characteristics as Cronbach's alpha can give us valuable information about properties of an educational test. Therefore, the estimation of reliability of the fixed tests is implemented into the ExaMe system.

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Bulgaria and the First Academic Assisted Distance Education in Telemedicine

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Abstract "Telemedicine" is a course, purposfully designed for the academical education in NBU, and it is performed for the very first time in Bulgaria. Except it`s content richness, this course is modern in the way of teaching – distance model with interactive information exchange, aiming to ensure the real going into the material essence. Besides the well-designed theoretical background, there are available multitude webbibliographic resources; multimedia – audiorecords, videomaterials and PowerPoint presentations, which ensure and stimulate the visual perception of the subject. In order to ensure the students with paper book for this quite new and modern application of the medical services, we have published the First Telemedicine Glossary of Working Documents, Glossary of Concepts. Technologies, Standards and Users, translated into Bulgarian mixtured with a Telemedicine textbook, which was approved by the European commission in 2001. Our goal is to present a working education program with one of the fastest developing distance software platform - Moodle, which not only helps the students to work at home with the materials, but to become familiar with the environment of telemedicine experts – through the distance, time and space. In our article we are going to define the current situation in Bulgaria – healthcare background, working projects, textbooks and already prepared lectures, completely comfortable to the western educational models. In order to introduce to the students the newest technologies today we use a lot of sources – not only WWW, but books from Amazon.com[10,12] and the opinion and experience of one of the most famous experts in telemedicine – Prof. Bernard Richards.

I. INTRODUCTION

The purpose of this article is to present new software platform and the essential form and content of the Master degree course "Telemedicine", thought in NBU.

II. METHOD ESSENCE

The term distance education represents a variety of educational models that have in common the physical separation of the faculty member and some or all of the students. As with all types of education, the various distance education models are built around the central components of the instructional process: presentation of content; interaction with faculty, peers, and resources; practical application; and assessment. Each distance education model uses technologies in various ways to address some or all of these components.

There are three basic models of distance education[25]:
(1)Distributed Classroom - Interactive telecommunications technologies extend a classroom- based course from one location to a group of students at one or more other locations; the typical result is an extended "section" that mixes on-site and distant students. The faculty and institution control the pace and place of instruction. The supporting technologies are:

- two-way interactive video (compressed or full-motion)
- one-way video with two-way audio
- audioconferencing
- audiographic conferencing

(2)Independent Learning

This model frees students from having to be in a particular place at a particular time. Students are provided a variety of materials, including a course guide and detailed syllabus, and access to a faculty member who provides guidance, answers questions, and evaluates their work. Contact between the individual student and the instructor is achieved by one or a combination of the following technologies: telephone, voice-mail, computer conferencing, electronic mail, and regular mail. There is no nedd for additional technologies

(3)Open Learning + Class

This model involves the use of a printed course guide and other media (such as videotape or computer disk) to allow the individual student to study at his or her own pace, combined with occasional use of interactive telecommunications technologies for group meetings among all enrolled students. The required technological solutions are the same as in Model (1).

Our choice is combination between the three of them, developed and assisted by an on-line solution. The software platform, that we have chosen is called Moodle. Moodle - "Modular Object-Oriented Dynamic Learning Environment" - is a course management system designed to help educators who want to create quality online courses. The software is used all over the world by universities, schools, companies and independent teachers. Moodle is an open source and completely free to use.

Another positive factor is that the platform is translated in 53 languages, including Bulgarian. Moodle

suggests A Moodle course is populated with activities in one of two ways; by adding a "module" instance from the Activities drop-down menu or by adding an internal or external Resouce. The following activity modules are discussed:

- Assignment
- Book (not standard)
- Chat
- Choice
- Dialogue (not standard)
- Forum
- Glossary
- Journal
- Lesson
- Quiz
- SCORM
- Survey
- Wiki
- Workshop

In Bulgaria there are already 27 registered sites in the home page of Moodle developers, and our`s is called "**Biotechnology on-line**" (Fig.1.).

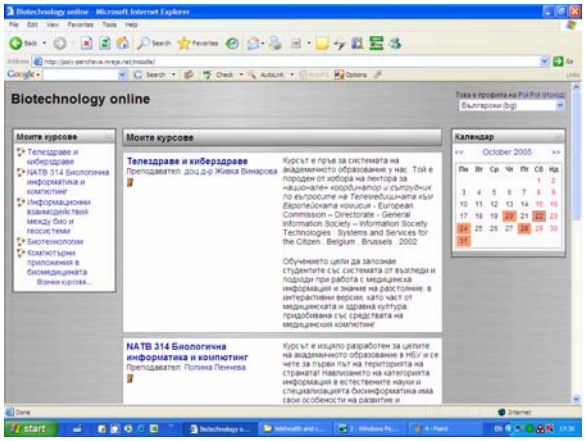
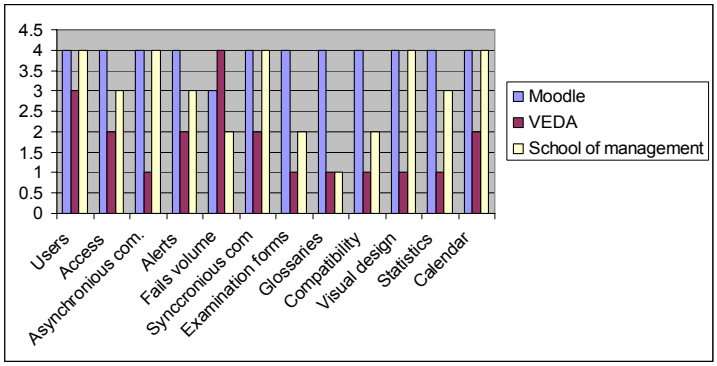


Figure 1. Platform preview

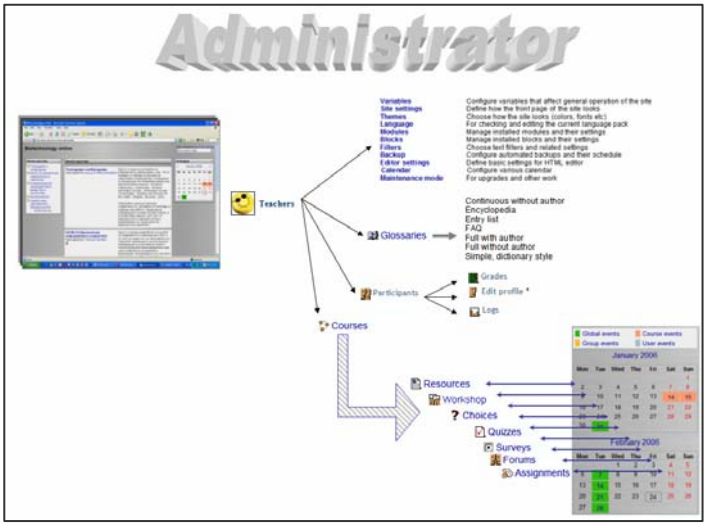
On the territory of NBU there are two working on-line educational systems – VEDA and School of Management. VEDA contains the course lectures, teacher`s CV, references, used in the course curriculum and etc.

The School of Management (SM) is a leading institution in distance learning of management in Bulgaria. It was established in late 1993 by decision of the Academic Council of New Bulgarian University. To date, the SM has trained over 2000 managers of different managerial level from various organizations. The programmes and qualifications offered by the school address the needs of practising managers - people (with or without a traditional academic education) who are already on the job, but need to acquire concrete practical knowledge of the dynamics of management theory and practice. It applies an innovative approach to the learning process – Self-Directed Development and Supported Distance Learning. The programmes of the School of Management at NBU are based on a wide range of modern techniques and technologies suitable for training practicing managers.

What we suggest is much more dynamic, user-friendly and realized with interactive tools, which ensures the active participation of the student. We have accomplished a comprative analysis between Moodle, VEDA and School of Management:

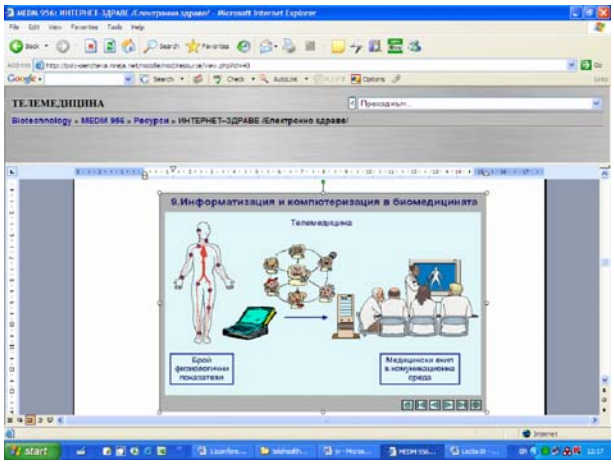


Figire 2. Comparative analysis



Figire 3. Administators functions

Fig.3 presents the functional characteristic of Moodle, the activities and blocks that are available to perform to the students and the responsibilities of teacher as a main integrator, developer and adopter of the system.



Figire 4. Course lecture

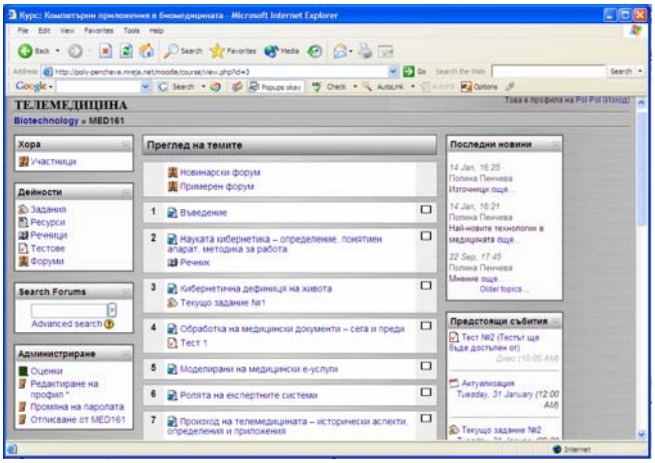
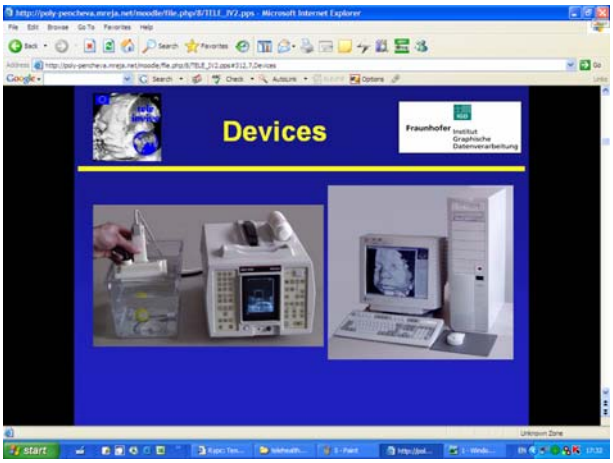
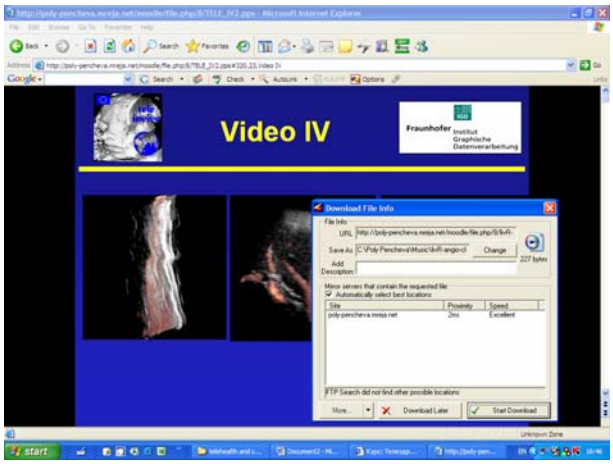


Figure 5. Course outline preview



Figire 6. Movie



Figire 7. Downloading movie

On Fig.4-Fig.7 we present some of our course lectures. There are the week preview of the course and activities, and some movies which we demonstrate on-line to the students, accompanied with the chance to download the files.

We have designed an inquiry with the purpose to check their satisfication and impression. The questions are:

Question №1 - Do you find the materials presented in more atractive way?

Question №2 - Do you approve the portals design and vision?

Question №3 - Have you met any difficulties during your work at the site?

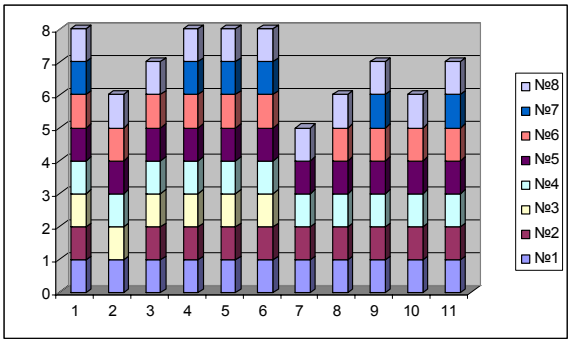
Question №4 - Do you consider this model facilitating your education?

Question №5 - Did that course change your informations base?

Question №6 - Do you have additional resources?

Question №7 - Does the site structure preposses you?

Question №8 - Do you consider usefull the forums?



Figire 8.Statistics

Another area of interes is designing and implementing new parameters for evaluation of web sites. Based on few experiments, we choosed these questions, which actually are not with equal value and we put mich more weight to some of them. The system generates a statistics, based on the students answers, but it combines all of the questions. Our purpose was to find out whether the students feel more informed by using the platform, which is Question N5. Another point of interest was whether they find it difficult to adapt (Question N3), and of course the result was that they are impressions are variable.

Building a course involves adding course attractive activity modules to the main page in the order that students will be using them.

In Bulgaria we are the first university that suggests Telemedicine education with an adaptive software platform, that allows the students not to present but to be always in touch. Our basic concept is to assisted and introduce the students with the modern technologies, accompanied with solid theory and lectures, and a lot of multimedia films, audio records and pictures of working telemedicine portals.

The program where this course is performed is a Master degree program, called Computer technologies in biomedicine – it`s a year and a half program, constisting of the following topics – Telemedicine, Telehealth and Cyberhealth, Medical Information Systems, Hospital Information Systems, Expert systems, Artificial intelligence, Mathematical modeling in biomedicine, Health economics, Bussiness strategies, and etc. s

The telemedicine course cyllabus is developed to introduce to the students the conception system and approaches in working with medical information and knowledge from distance, with interactive versions, acquired through the technologies of medical computing.

We are the first academic institute which propose a telemedicine education in Bulgaria, which is provided with the first Telemedicine textbook and Glossary for the bulgarian scientific society (an European project for translation and adaptation of the Fifth edition of Glossary of Concepts. Technologies, Standards and Users, September 2003, European Commission, Information Society Directorate-General, Brussels)[1].

Telemedicine Curriculum [7]

1.The system Telemedicine as a dynamic sum of different components, united by specialized purposes and common functions.

2.System analysis as an educational methodology

a) It`s selfconnected components;

b) It`s general system characteristics;

c) It`s interaction with the environment (social, informationa and medical) .

3.Historical telemedicine development as differing dynamic unique interactions:

a) *technologies* (information and telecommunication – local medical information infrastructure for inteconnections between users and delivers);

b) *techniques* (medical dicagnostic and registering technologies, systems – store, transform and transphere medical information);

c) *software background*;

d) medical qualification – as a knowledge base and practice

e) *users* (medical and health experts or patients) - Telemedicine Information Exchange. A navigation tool for global telemedicine information;

f) *technology and service service providers;*

g) specific exploatation regimes of techique and medical date exchange format*;*

h) *standards and recommendations for service quality*; - Impact of telecommunications in health care and other social services. Recommendation SG2/6-98 of the above International Telecommunication Union (ITU) conference ,

i) *financing institutions*

4. Some definitions

5.Purposes and problems of telemedicine asa part of the modern information society

6.Application areas and tendentions for use

7.A variant of functional classification

8.Cultural phenomena, which follows from those interpersonal communication in the healthcare, treatment and education as a new technology for cooperation and society development.

9.Comparative analysis with other Automate Information Systems (AIS) in healthcare

10. Logical connections with "scientifically grounded medical practice and healthcare" – two modern requirements for the profession

11. Some legal and ethical problems and regulatory mechanisms

12.Unique telemedical interdisciplinarity – as a joint and coordinated professional exptression of techlogy, software, informatics, legal, financial, medical and healthcare experts – with accents on the professional challenge.

13.Aviation and cosmic medicine as telemedicine versions – comparative analysis

14.Some technical and technological conceptions and schemes

15. Telemedicine benefits

Our concept is extremely well reflected at Fig.9 – the interconnection between the four applications, united by e-health.

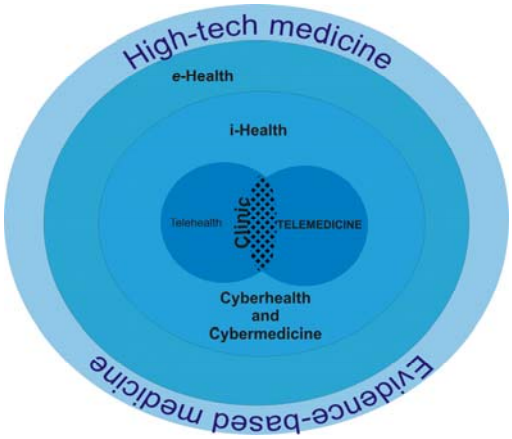


Figure 9. Schematic definition of interconnection between medicine sciences and applications

Our basic definitions and fundamental points are:

(1)Telemedicine – The provision of health care services, clinical information and education over the distance using telecommunication technology – existed long before the Internet. So interactivity is not a necessary part of the transaction!

It is the "use of information technology to deliver medical services and information from one location to another".

(2)Telehealth is more encompassing term then telemedicine, wich they define only as restricted to interactive patient/physician teleconsultation

Telehealth: The provision of health care at a distance (using ICT facilities)

(3)E-Health: "E-health is a new term used to describe the combined use of electronic communication and information technology in the health sector" OR is the use, in the health sector, of digital data-transmitted, stored and retrieved electronically-for clinical, educational and administrative purposes, both at the local site and at a distance.

III. CONCLUSION

The learner and library support are also important aspects our platform. We have achived good results from the tests, and now the challenge would be to perform more educational materials, to overcome the scare in students and teachers from other courses and programmes, to provide user guides and classes for both types of consumers, and to introduce the platform as a fundamental way of studying not only for strongly specific courses as Telemedicine.

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Telemedicine for Infections Control

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Abstract-Infections are known as the world's largest killer. They account for more than 13 million deaths a year. Most of these deaths occur in countries with low- and middle financed healthcare. All this becomes worse by the huge increase in migrating of large mass populations over the past decade, because of war, famine and natural tragedies. In Georgia creation of system for prevention and control of infections with the help of telemedicine was initiated. Its mission is the increasing of healthcare access by assuring a public health professionals workforce that meets the needs of the public. The main goal of this system is the effective implementation of the training of medical personnel to identify and respond to public health crisis and comprehensively coordinate public health actions.

I. INTRODUCTION

The last decades were characterized by the intensive development of info-communication technologies and their application for different aims. As a result of usage of mentioned technologies for healthcare aims the new field, telemedicine, was created. It is working out by the developed countries, but developing ones can use them in the most effective degree. Telemedicine is rapidly developed and the tendency of optimization and development of its solutions in accordance with developing countries' claims could be observed. As a result medical service in the developing world could be turned into a communitarian and safe practice [1]. Virtual healthcare become more and more realistic [2].

Through telemedicine technological possibilities distance consultations and lectures became reality. Taking into account the possibilities of telemedicine, it can be effectively used for infections diagnostical, treatment and control purposes. In particular, for trainings of medical personnel, epidemiology, information monitoring, databases organization, creation and update of informational web-pages, contact with world organizations and infected countries for the aim to realize exchange of epidemiology, virology and pharmacology data, for fast communication in healthcare system and also for public education purposes.

The health of the citizen has always been, and will continue to be, a critical issue for all governments [3]. The conversion from traditional health strategies to eHealth is a giant, but inevitable step. There is evidence in several countries that the use of information and communication technologies improves access to care, increases satisfaction and supports access to a vast amount of biomedical and health information by both individual citizens and healthcare providers. However, the way to mass use of eHealth applications is not yet paved [4]. Throughout the world the number of people requiring special care is increasing as the proportion of elderly people rises, at the same time, in a high tech age the expectations of the society for a better healthcare are also rising. Telemedicine offers the opportunity for improving healthcare services and for making healthcare expertise available to underserved locations.

Telemedicine for infections control is the wide scale eHealth action which is implementing in Georgia for the aim to ensure the interconnectivity for healthcare services and professional medical education with special emphasize upon formation of the background for creation of eHealth network in Georgia. It is implementing through the usage of the Virtual Organization technology.

Taking into account the objective that the application of telemedicine for infections control aims organization and implementation of distance consultations and lectures for diagnostical, treatment, control and epidemiology purposes, the well-known schema [2], the present article will focus upon another innovative aspects, in particular upon description of approach of Virtual Organization and its application for telemedicine purposes, eLearning and problems to be solved.

II. VIRTUAL ORGANIZATION AND TELEMEDICINE

Virtual Organizations (VOs) are a set of individuals and/or institutions that have direct access to computers, software, data, and other resources, and to share resources in a highly controlled manner, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs. VOs very tremendously in their purpose, scope, size,

duration, structure, community, and sociology yet they all involve a broad set of common concerns and requirements, namely: the need for highly flexible sharing relationships, ranging from client-server to peer-to-peer; for sophisticated and precise levels of control over how shared resources are used, including fine-grained and multi-stakeholder access control, delegation, and application of local and global policies; for sharing of varied resources, ranging from programs, files, and data to computers, sensors, and networks: and for diverse usage modes, ranging from single user to multi-user and from performance sensitive to cost-sensitive and hence embracing issues of quality of service, scheduling, co-allocation, and accounting.

Current distributed computing technologies do not address the above concerns and requirements, and it is here precisely where VOs' approach comes on the scene. Over the past five years, research and development efforts within the VOs community have produced protocols, services, and tools that address precisely the challenges that arise when we seek to build scalable networks. Basic technologies supporting VOs include the Internet and the World Wide Web telecommunications, electronic mail, groupware, and video conferencing.

The VO concept has several aspects, including the following:

- It is a set of individuals, organizations and resources that group together for a common purpose which is likely to involve some form of sharing;
- It crosses existing conventional organizational boundaries;
- An individual or organization may undertake specific roles in a VO;
- An organization may make some of its resources available by means of a VO;
- A resource could be a low level concept, such as providing computer power which could be used for any software within a given class or some more application-oriented concept such as a business process;
- VO policies are required for sharing resources, for stating conditions under which resources are required or offered and for authentication among the members of a VO and between the VO and the outside world;
- A VO is supported by the idea of services being provided, published and requested.

It is well known and obvious that eHealth has a great potentiality; however there are unfortunately today only a few examples of its large commercial services. The benefits of expanding eHealth and telemedicine use are threefold: it can improve the quality of healthcare services; it will allow a better exploitation of limited hospital resources and of expensive medical equipment; it will help to address the problem of unequal access to healthcare. VO technology will offer the opportunity for improving healthcare services and for making healthcare expertise available to underserved locations.

The probability of an incorrect handling of a relevant pathology is still dangerously high, mainly due to:

1. Environmental factors – many medical organizations are not fully able to face every disease, e.g., in a peripheral hospital only the most frequent pathologies for that geographical area are treated.
2. Instinctive factors – the decision making of a physician is usually mainly based on the limited number of cases in her/his experience and/or on a static medical knowledge available from databases of main published studies. This factor is very variable between different specialists and general practitioners.
3. Emotional factors – medical decisions are often influenced by the opinions and the decisions that have been taken by the physicians that already have examined the same patient.

As a consequence the probability of a serious error occurrence is high and the probability of its recognition and correction very low. This frequently causes a repetition of exams in the same or in different medical units and it slows down the diagnostic process (resources waste) and the proper treatment. So, proper actions for improving the working procedures should be taken. Correct medical information management and transmission is a key point, hence the introduction of innovative technologies can be relevant.

The main applications of the present initiative which aims infections control with the help of telemedicine will concern: data and medical support services, multimedia patient record handling and teleconsulting (one to one and/or multipoint). On the other side the main applications that will be implementing for eLearning are: video lessons (live and/or on-demand), a media library, and a laboratory collaborative learning environment. Since the request for more effective health services is increasing over the years, through implementation of eHealth and telemedicine the present initiative will be focused upon:

- Improving the performance of the healthcare services;
- Optimizing the running costs of the healthcare structures and the allocation of resources.

For this reason the principle of "delocalization" will be implemented, in particular information, i.e. knowledge and skills, will be moved, rather than people and tools. It is plausible, that such approach will provide an answer to such an evolution to eHealth.

III. eLEARNING

eLearning may be defined as the application of communication technologies to acquire new knowledge or skills across the whole range of areas which will affect healthcare professionals, and enrich their experience in rendering the best possible care to patients through out the process of medical care. eLearning has the abilities to apply new concepts, and ideas in which the learner becomes an owner of that knowledge, without any respect to distance. As

such, eHealth overall, and in particular eLearning, is significant part of healthcare revolution, since the event of modern medicine. eLearning is focusing on the following principal issues:

- Distance learning;
- Continuous medical education (CME) for medical professionals;
- Advanced eHealth professionals education in the changing environment;
- Patient's education in healthcare related issues in the information age.

eLearning can effectively:

- Reduce the medical errors;
- Help manage the knowledge and information, and support the decisions making process based on evidence based practice guidelines;
- Ensure better communication between healthcare providers and patient;
- Advance the goals of redesigning the healthcare systems.

As a result, the core competencies will help implement new evidence-based medicine protocols, and support the notion that, every citizen of the world need to receive the best possible existing care.

The implementation of eLearning remains one of the most important issues among current health challenges, that are staggering and numerous, as illustrated by numerous studies:

- Only in the USA each year 98,000 people die from medical errors, more than those who die from motor vehicle crashes, breast cancer, or AIDS;
- Other challenges include the lack of the "best system", poor accommodation of patients' needs, inability to assimilate the increasingly complex scientific advances, failure to address the growing consumerism among the patients;
- Healthcare provider's workforce shortage and discontent.

These are important issues that have led to medical errors, poor quality of care, and dissatisfaction among patients and healthcare providers. In this environment of technological advances, information technology and evidence based medicine has the potential for transformation of healthcare. The integration of more recent advances and visions with goals of the institutions, nations and more broadly of the world is the main challenge, however.

eLearning is a very important element of overall progress in the eHealth. In order to be able to advance this, as an accepted culture and part of the daily practice of healthcare professionals, there are many initiatives that need to be taken, or existing one to be supported. The public at large has great expectation for application of telemedicine technology. The following are the most important aspects of this use:

- Internet technology applications have real potential in all aspects of health education world wide;
- May help establish higher standards for medical education, CME, education of public and carrying out specific programs;
- Has the technical capability to ensure dissemination of knowledge and create new standards, especially in developing countries since the Internet will be the method of choice for delivering not only direct medical care, but most importantly eLearning for both patients and healthcare professional even in the most remote sites of the world.

Few issues that need resolved in order for eHealth education to prosper and be accepted are:

- "Product" acceptance by traditional medical educators, scholars, and legislators;
- Changing the old style of education to the new one and thus breaking the "traditional" classroom medical teaching and learning methods;
- Lack of capability and availability of technology in most of the world for disseminating the knowledge, or in other words lack of communications;
- Language and cultural diversity;
- Socio-economic and political status of the countries in need for eHealth education;
- Legislative policies and championships for new information age.

IV. Problems to be solved

The healthcare systems, and the education of healthcare personnel, have to be re-organized to systems that function in a cross-border fashion. Prerequisites for this development shall be a specific emphasis on equity of access, interoperability and standardization of systems and protocols, security and legal aspects. There are technical, legal, organizational and financial problems to be solved.

Technical problems – although the technologies needed mostly do exist already today, there are still area-specific technical barriers that have to be overcome. The most prominent barriers are easy-to-use, intuitive, robust and smooth user interfaces and devices. The services must be offered to all users (in particular also to the elderly and the disabled) through such interfaces, and all of them have to be implemented in a uniform way. The access to the systems must be smooth and transparent to the users. Otherwise they won't achieve a good acceptance.

Also the lack of availability of data in an electronic format and the lack of modeling for some diseases and extreme weather events might reveal an important barrier for a global prediction and management of emergencies and natural disasters.

Legal problems – the legal barriers that have to be overcome are essentially the general ones applying to the whole health telematics field. Responsibility, confidentiality, liability and access only to certified professionals are some of the key issues.

Organizational problems – there are serious organizational barriers, however, such as healthcare at home requiring smooth collaboration of different organizations. This requires a significant redesign of business processes, which is only possible if a change from the enterprise-centric view to a system-wide perspective with the patient/citizen at the centre is achieved. Today the paradigm of service chains in healthcare, built on info-communication technologies based collaboration of service providers linked in a service provision network, is still in its infancy. However, the increasing interest in recent approaches like managed care, disease management, and case management which are strongly related to this paradigm shift shows that the necessity of changing the way in which healthcare systems are organized is more and more recognized and continually becomes transparent. Also country-specific factors, such as the roles of different providers of health and social care services, insurance companies, housing providers, local authorities, and telealarm providers, need to be taken into account when introducing healthcare at home.

Financial problems - the financial barriers largely depend on the different countries' policies. In countries with national healthcare systems these services will be a part of the overall healthcare system. In insurance based countries, where services are reimbursed on a fee-for service basis, new codes will have to be established. In countries with market-driven healthcare systems the prices need to be adapted to market prices driven by the healthcare consumers. At this time there is little evidence on how the broad implementation of such eHealth and telemedicine services will affect the financial situation of healthcare systems in total, and its participants in particular. The challenge is to create comprehensive systems (networks of services offering the basis for patient-individual service chains) which are financially beneficial for all players.

Other problems - furthermore, the awareness of the great opportunities that eHealth and telemedicine can help to solve the huge problem of an "elderly society" and the problem of isolated areas has to be promoted in both citizens and politicians.

Stakeholders, including healthcare professionals, researchers, public officials, and the lay public, must collaborate on a range of activities. These activities include initiatives to build a robust health information system that provides equitable access, development of high-quality, audience-appropriate information and support services for specific health problems, and health-related decisions for all segments of the population, especially for underserved persons, training of healthcare professionals in the science of communication and the use of communication technologies, evaluation of interventions, promotion of a critical understanding and practice of effective health communication both for end-users and for healthcare professionals, and initiatives to gain knowledge about eHealth consumers' use of and their needs and attitudes with regards to information and communication technologies in healthcare.

Barriers - in spite of the potential which eHealth has as a mechanism to support healthcare systems, a number of barriers, at various levels, would need to be overcome for healthcare systems to take full advantage of these opportunities. These barriers are not unidimensional, focusing on technical knowledge as previously assumed, but rather a multidimensional construct, encompassing technical knowledge, economic viability, organizational support and behavior modification. Three most important barriers to eHealth adoption where identified as: the problem of interoperability (technical, cultural, systematic, financial reimbursement, inter-organizational workflow), acceptance of a "new" healthcare system, and regulatory constraints. This emphasizes that European eHealth implementation has to be accomplished by simultaneously horizontal and vertical multisectoral action.

Interoperability - interoperability is a key challenge. This is the fragmentation problem - many pieces of information, in many formats, on many platforms, in many stakeholder environments, and in many geographic locations. The data sets are thus heterogeneous both physically (stored in different locations) and logically (not organized in the same fashion) accentuating issues of interoperability that are raised by lack of compatibility of systems and equipment. The problem of interoperability is not limited to technical standardization as typically assumed, but encompasses the complex issues of integrating cultural, financial and workflow systems. Ensuring that the 'ways of working' of health systems are interoperable is a major challenge.

Acceptance - acceptance of eHealth presents a particular challenge. It is important to promote the use of automated tailoring of information access and summaries to accommodate variations in culture, language, literacy, and health-related goals, as well as integrated decision-support systems that can proactively foster best practices. Unfortunately, collection and delivery of the necessary epidemiological and patient data on which such systems must be built are problematic. However, once collected, eHealth can be used for timely transfer of data to central services for planning and management purposes. At the organizational level, revolutionary advances in medicine and technology as a whole during the past few decades have resulted in shifts in the boundaries between hospitals, primary healthcare, and community care. In the future, eHealth is likely to add to this by changing the way in which healthcare services are provided, from clinical messaging (advice, results and referrals), to distributed electronic health records, increased connectivity between health services, patient appliances to assist self-management, and the use of technology to improve communication. These changes need to be sensitive to acceptance concerns related to changing established medical traditions, professional autonomy and loss of control.

Regulatory constraints - liability in connection with standards of care and medical malpractice, responsibility for security and confidentiality of patient-specific information are major legal challenges. Owing to the computerized communications involved in eHealth, determining where transactions occurred, which laws apply and which courts have jurisdiction will be problematic. At the policy level, challenges include professional standards of providing care and licensing of care givers, and regulation of medical

devices and eHealth application software. eHealth is currently unregulated, unlike all other aspects of the health system. eHealth also raises or accentuates ethical, legal and policy issues. Confidentiality of information, protecting the privacy of patients and safeguarding the integrity of information will present significant challenges with increasing use of eHealth. There will also be gender issues to be addressed and model guidelines will be needed to resolve problems brought on by cultural differences among countries engaged in eHealth activities.

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Telehealth Model between University and Primary Care

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Abstract- A Telehealth model has been developed by the Federal University of Minas Gerais (UFMG) and the Municipal Administration of Belo Horizonte since 2004. A telehealth network was implanted first in Belo Horizonte, and currently extends to other cities in Minas Gerais state, linking the university to inland health centers to support the family health teams in their daily work. The main telehealth activities are permanent education and second opinion in clinical cases, focused on primary care professionals from medicine, nursing and odontology. The assisting support is based on spontaneous demand, using online technology for complex cases and offline for simple ones. The educational support is provided through teleconferences according to professional necessities. A simple model of technology is used, based on computers with webcams, management and communication software packages, allowing simultaneous online access of multiple basic health units with image, voice and text interaction. During the first 2 years of implementation there have been performed 151 telehealth events, with the participation of approximately 2,025 health professionals. The Ministry of Health in 2006 integrates in a pilot national project the biggest Brazilian public experiences in telehealth in order to support the family health teams. This projet will benefit around 10.000.000 inhabitants.

I. INTRODUCTION

Brazil is a country with big territorial dimensions and huge social, economical, cultural, geographical and infra-structural contrasts. All these facts generate big differentiations in terms of professional qualification, which justify the large range of services qualities found in the health care to the population. Within this context, it is proved the necessity to deeply use information and communication technologies in health, to support the professional that are settled in distant and poor regions in the country.

According to the Brazilian Institute of Geography and Statistics (IBGE), in 2000 the country had 169,590,693 inhabitants, living in 5,507 cities [1]. About 88% of these cities had the population ranging from 2,000 to 50,000 citizens.

Still according to 2000 census, Minas Gerais has a population of 18,030,458 inhabitants and 853 cities. About 88% of these cities have a population of less than 30,000 inhabitants and 60% less than 10,000 [1].

The Unique Health System of Brazil (SUS) was created by the Federal Constitution in 1988 to reorganize the services and actions in health. It was created to decentralize the former health system.

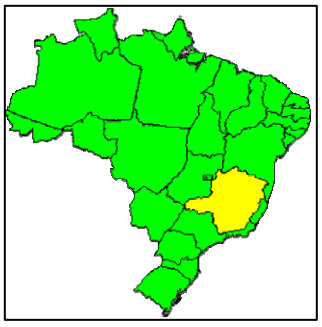


Figure 1: Minas Gerais in Brazil

SUS presents the principles of universality of access, integrity and equality in assistance, participation of the community and equity. It is a complex system, with huge numbers. For instance, it realizes, according to the Health Ministry, 72,000 heart surgeries and 132 million high complexities procedures each year [2]. However, 80% of its attendance is concentrated in the primary level, which is the main entrance form to the system.

In 1994, the Family Health Program (FHP) was created by the Federal Government to reorganize the health attention practices and amplify the access of all citizens to integral and continued treatments. It was formed family health teams, composed by a doctor, a nurse, auxiliary nurses, people from

These projects are financed by @LIS, from European Union (coordinated by GVC – Civil Volunteer Group from Bologna, Italy), Health Ministry of Brazil and FAPEMIG (Research Support Foundation of Minas Gerais).

inside the communities and a dentist (only in some teams). They work mainly with the prevention, promotion and re-stability of health. Nowadays the program is implemented in 84% of the Brazilians cities. According to Health Ministry data, in November 2005 the country had 24.269 teams, responsible for 100,000.000 inhabitants. In Minas Gerais, there are 3,064 teams; 532 of them are in the capital of the State, Belo Horizonte.

However, a large number of barriers need to be transcended, for example, the academic formation and permanent education of the professionals of the family health teams, the low level of resoluble attendances in the primary care and the reference and contra-reference system. Despite the efforts of the Health Ministry, the number of residences programs in Family and Communities Medicine in Brazilians medical schools are still insufficient. The consequence of this is the high number of professionals that leave the teams, because they are not prepared to be isolated for a large period of time and also need to study or specialize in the big economical centers.

To deal with this scenario in the health primary care, the Federal University of Minas Gerais (UFMG), together with the Municipal Health Department of Belo Horizonte, developed a telehealth system to support professionals of primary care system in the city of Belo Horizonte. With the sponsor of the State Health Department, the project reaches nowadays others cities in Minas Gerais, with a focus on telecardiology. Also, Brazilian's Health Ministry launches a pilot project of telematics, which is a technological tool to promote teleducation and telemedicine seeking the qualification of FHP teams distributed around all the country.

The objective of this paper is to present the experience of Minas Gerais with telehealth uses in educational and in assistance proposes, which is now inserted in a big national project of telematics and telemedice of the Health Ministry of Brazil.

II. METHODOLOGY

The BH Telehealth system considers aspects as simplicity, efficiency and low investment. Its implementation started in 2004 and it has been growing in structured steps. Today it is installed in 30 Basic Health Units (BHU), where the new routines and activities gradually are taking on.

The methodology is based on teleconferences for permanent education and teleconsulting or second opinion. Through this system a professional of the primary care can have a remote second opinion and discuss clinical cases, in real time, with a specialist in the University.

The educational teleconferences are used in medicine, nursing and dentistry. In each different area of knowledge there is a variation on the methodology to list the themes, but always reflecting the necessity of the professionals.

The teleconsulting or second opinion can happen both on line and off line, following criteria of security and confidentiality.

Off line teleconsulting is used to discuss simple and punctual cases using an internal e-mail system.

To more complex cases, professionals schedule a virtual meeting, using the on line teleconsulting image, voice and data resources.

The first step to implement the project was to build a network integrating the communications systems from Municipal Health Department and UFMG. The Clinical Hospital (from UFMG) was connected to all the BHU. After, the medicine, the nursing and the dentistry schools were incorporated to this system. After several tests, the ideal connection was established at 128 kbps, with no loss in quality.

The UFMG network is connected to the high performance National Research Network (RNP). This one is connected to international researches networks, like CLARA, in South America, and GÉANT, in Europe. In this way, it is possible to establish a connection between the Clinical Hospital, in Belo Horizonte, for instance, and the Centre Hospitalier Universitaire de Rouen, in France. These two institutions have international cooperation accordance. Because of this, videoconferences are frequently taken between medical services from both hospitals, which can be transmitted on line to the whole primary care service in Belo Horizonte.

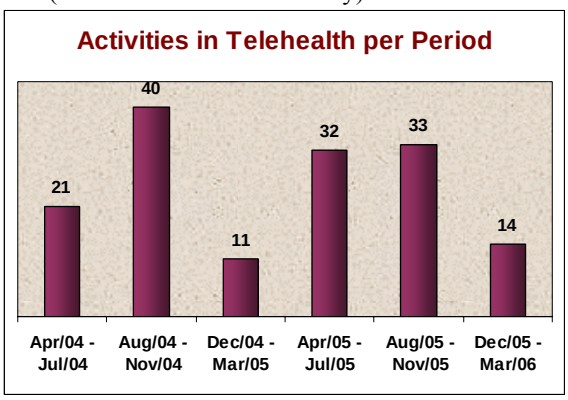
The proposed model considered the necessity in transmitting activities in telehealth to different BHU simultaneously. For this, it was selected a videoconference multi-point software, which allows image, data and voice transmission, besides the share of electronic health records, medical images or necessary didactic material. Teleconsulting and teleconferences occur through this software.

The project team developed a telehealth management software that allows professionals to order different kinds of activities, to schedule teleconsulting, to register specialists reports, among others. Besides that, professionals can access statistic and management reports and also the off line teleconsulting e-mails. This software was developed in PHP. Data are stored in My SQL and hosted in Linux platform.

It was chosen a simple and low-cost hardware, which is a microcomputer with multimedia and webcam.

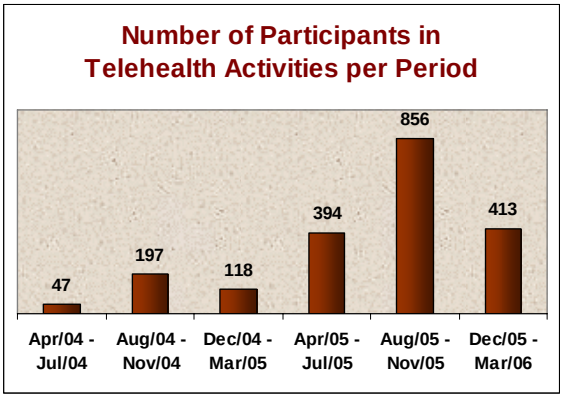
III. RESULTS

Graph 1 shows the activities in telehealth developed since the beginning of the project. Lately, the number of activities is stable, decreasing in the months that Universities are on vacation (from December to February).



Graph 1: Activities in Telehealth

The number of participants, shown in Graph 2, is increasing with the time. It is explained because of the expansion of the project and because of the routine created to the activities in telehealth. With settlement of new BHU's and its expansion to nursing and dentistry fields, it shows singular growth to telehealth activities.



Graph 1: Participants in telehealth activities

Table I details the telehealth activities done in the BHTelehealth project. The activities are distributed in telemedicine, telenursing and teledentistry. The activities in telemedicine are teleconsulting with second opinion (104 activities), teleconferences (10) and international and national videoconferences (12), summing up 771 doctors involved.

In telenursing occurred 20 teleconferences and teleconsulting events, with 898 professionals involved. In dentistry, the activities started in November 2005. Five teleconferences were held and 356 professionals participated.

In total, there were 151 activities during this period, with 2,025 participants.

TABLE 1
NUMBER OF ACTIVITIES AND PARTICIPANTS IN THE BH TELEHALTH PROJECT, BY AREA

TYPE OF ACTIVITY	NUMBER OF ACTIVITIES	NUMBER OF PARTICIPANTS
TELEMEDICINE (Apr/04 - Mar/06)		
Teleconference	10	198
Teleconsulting	104	228
National and International Videoconference	12	345
TOTAL	126	771
TELENURSING (Dec/04 - Mar/06)		
Teleconference	15	883
Teleconsulting	5	15
TOTAL	20	898
TELEDENTISTRY (Nov/05 - Mar/06)		
Teleconference	5	356
TOTAL	5	356
TOTAL	*151*	*2,025*

The teleconsulting activities were able to solve the problems in 71% of the discussed cases while patients were still in the BHU, avoiding taking them to the secondary level. The most demanding specialties were dermatology, endocrinology, cardiology, pneumology and pediatrics. Teleconferences demonstrated to be an important instrument for on line training and it is also continuously increasing the interest of the participants.

F. Expansion – Telecardiology Project: Minas Telecardio

From an initiative of the Health Department of Minas Gerais State, it was formatted a project to the implementation of a telecardiology system in 80 small cities in Minas Gerais. It is a research project that includes measuring its effectiveness and its implementation and operational costs. It focuses on cardiovascular diseases and also seeks to deliver strategic information to public health policy managers in the State.

According to statistical data from Health Ministry, cardiovascular diseases are the major cause of diseases and death in Brazil [1]. High level of morbidity, high level of death and high cost of theses diseases show to public policy maker that it is necessary to prioritize the preventions and treatments in the State. The territorial dimension and the socio-economical contrasts suggest that telemedicine techniques have a great potential to optimize the assistance and the permanent education to the health professionals. Telecardiology could be an interesting alternative to upgrade the medical services system with a capacity to treat more specific diseases.

To assure that this project will have a successful implementation, a group of five Minas Gerais Universities agreed to participate, under the coordination of UFMG, because of its experience in telehealth. It was formed, then, The Telecardiology Network of Minas Gerais, which includes UFMG, Federal University of Uberlândia (UFU), Federal University of Triângulo Mineiro (UFTM), Federal University of Juiz de Fora (UFJF) and State University of Montes Claros (UNIMONTES). The five "schools hospitals" of these universities will form the pools, showed in figure 2, responsible each one for 16 cities nearby.

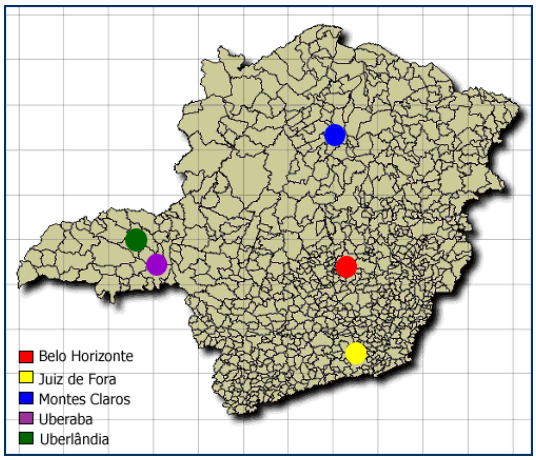


Figure 2: State of Minas Gerais and the five cities of the pools

Considering that cardiovascular diseases are the major causes of morbidity and mortality in small and poor cities too, the Health Department of Minas Gerais stated the following parameters to select the candidates cities to receive investments in telemedicine application:

1. Cities with high level of attendance by the Family Health Program – FHP equal or higher than 70%
2. Cities with more than 10,000 inhabitants
3. Cities in macro-regions with higher morbidity levels of myocardium infarction.
4. Poor cities, with low levels of morbidity caused by myocardium infarction, to avoid the under-notification (usually, poorer regions do not stat data correctly)

In participants cities will be installed a digital electrocardiograph and a microcomputer to the teleconsulting and permanent education system which is already working in Belo Horizonte.

It is expected that the project activities allow:

- To get precise information about cost and effectiveness of the use of telemedicine in cardiac patients;
- To equip, to educate and to qualify the health teams in cities with less than 10,000 inhabitants so that they are able to have electrocardiograms exams and assist to cardiac patients;
- To improve the attendance to patients with cardiac diseases in the State of Minas Gerais, expecting to reduce the morbidity and the mortality;
- To establish a model to telemedicine, telecardiology with tele-electrocardiogram and telehealth to be disseminated to other levels of the public health system;
- To qualify human resources in telemedicine area, in universities hospitals.

G. Telematics and telemedicine project in support to the primary care in Brazil.

The Health Ministry of Brazil propose this pilot project to use telematics and telemedicine to support and educate teams from FHP in a national level.

It will be installed eight centers in the country that, in the first moment, will connect to 800 technical points. The eight pools are São Paulo, Minas Gerais, Fortaleza, Goiás, Pernambuco, Porto Alegre, Santa Catarina and Amazonas, showed in figure 3, reaching all the regions of the country. This project will benefit around 2,400 family health teams that look after approximately 10,000,000 citizens.

The Amazon deserves a special interest, once it is a region that, on the health and education points of view, can be reached only with the use of telecommunication and informatics technologies.

This project integrates many important brazilian institutions as University of São Paulo (USP), UFMG, Bireme, OPAS, FIOCRUZ, Community and Family Brazilian Society, in partnership with other Ministries, such as Education, Defense and Telecommunications.

Figure 3: The eight pools

The expected result is the improvement of the quality of primary care of the Unique Health System of Brazil, and consequently in the population health.

IV. DISCUSSION

The implementation of the telehealth system in the public health system of Belo Horizonte, connecting the UFMG to the municipal primary care, brought interesting results up, which supports the idea of its expansion to others cities in the state, with the focus on telecardiology. Heart diseases were stated as priority to the health system in the State, once cardiovascular diseases are the major causes of morbidity and mortality in Minas Gerais. This experience is now part of a great national project, from the Health Ministry, to use telematics to support the primary care.

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Session 5

IT Solutions in Healthcare

Visual Communication for Healthcare

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I. INTRODUCTION

While no currently available technology can completely substitute for the in-person physical examination of an individual patient or specimen, the Visual Communication Technology available today can provide high quality, high resolution long distance images which can bring a significant and valuable tool for physicians and other medical professionals who are unable to examine a patient or specimen in person.

Video has become the number one tool to increase the efficiency of daily routines, provide equity of care, more efficient administrative routines, and improve considerably continuative medical training and clinical support through interactive, real-time communication.

The entire video industry has undergone dramatic changes during the last few years. Video Industry has brought to the market reliable, high-quality, scalable and secure video solutions that allows assessments to be conducted confidently.

Today, with one click, anyone can connect from any location regardless of protocols and network barriers. More important the content of the information will be kept to the high level of confidentiality, due to the latest encryption technologies.

We will examine with concrete cases how far and reliable is the technology today, how standardization plays an important role among different providers and what we will expect to see in the near feature.

II. CONTENT

The intention of this document is to cover aspects, considerations and experiences related to the followings areas:

- Why Visual Communication in Healthcare?
- Technologies & Applications in Hospital
- Economical Evaluation
- Telemedicine Programs
- Open Standards

Without computers much of modern medicine would be impossible. For instance, using IT to manage radiography and other images can bring substantial improvements in speed and efficiency. Yet to get the best out of such installations it's important to have well thought out plans which slot developments such as PACS or EPR into overall Hospital Information Systems (HIS) installations.

III. WHY VISUAL COMMUNICATION IN HEALTH CARE

The Visual communication is growing simply because there are several and important key activities and real Advantages that are driving the telemedicine applications:

- Improves QUALITY of cares and COLLABORATION, because specialty expertise provides a more rapid and reliable assessment of images and sounds transmitted
- Improve ACCESS and TIME SAVING, because getting the right patient to the right place at the right time
- Improve patient COST with Reduced travel expenses, because travel cost for specialist treatment at the regional centre as well costs incurred in Specialists moving to/from different regional care centers
- Improve the Medical NETWORK NATIONWIDE to benefit from other doctors' expertise and to participate in educational broadcast

It is also very important to note that connectivity has played a crucial role in the past years. Today the "*Easy to connect*" approach has marked several communication initiatives in to the medical communities. This is mainly because there are more:

- Familiar methods like Telephony & Instant messaging ready available for the community;
- Efficient ways than before of working from home office or working in remote locations.

This overall picture means clearly that we have achieved in our communication community more:

- Secure, scalable and manageable networking capability. Everyone feels more confident and safe when working form home or in a mobile environment.
- Better and tight integration into IP communications and rich media solutions through the modern telecommunication operators

IV. TECHNOLOGIES & APPLICATIONS IN HOSPITAL

The Visual communication is growing also because there is a tighter and easier integration among different platforms into the overall Hospital Information Systems (HIS) installations.

Looking at the Technologies and Applications in the Hospital Information System (HIS) we can emphasize 4 different layers:

- *The Clients level*, where the interface between the Physicians and the Infrastructure tool is located. This area is comprehensive of all the medical devices, the interactive patient software, the hospital management system, the mobile and fixed phones and all wireless devices, all of them connected to the Hospital infrastructure. At this level we can find the Videoconference terminal connected to the medical devices or to a standard conference room.

- *The Infrastructure level*, where all the network resources are located. The infrastructure allows communication to be alive. The infrastructure is the physical interface between the hospital communication system and the network providers. This is the strategic area where investments are made at the Hospital strategic level. Equipments and Management tools that are located in this area will allow the correct functionalities and interfaces among different platforms and vendors. Interoperability at this level. is a key factor and an important element that drive the hospital road map.

- The Services level, where the Hospital is able to create a valued added medical resource. Service is an important area that allows the hospital to deliver clinical support to their patients and their medical stuff.

- The *Application level*. Here the services are channeled to reach the specific application area. This is where the hospital is able to address medical and educational support on a large scale.

V. ECONOMICAL EVALUATION

The Visual communication has unique market drivers to expand and explore the classic working methodology. The following list is purely an extract of some of the most common today:

- Telemed extend the geographic reach of health care to provide Equity of Care
- The need to cut healtcare costs drives the National Agenda
- Decreased Travel cost at any level
- Availability and priority in using Air /Ambulances
- Professional isolation in rural areas is avoided
- Reduced patients volume in Main Care Centers
- High level of user satisfaction

Not always is possible to mark positive advantages while adopting new technology. The following list is briefly describing some of the most common challenges while adopting new methodologies and technologies:

- Financial viability may prevented wider implementation
- Lack of solid financial model
- Several Telemed programs are finding little cost saving to support themselves once the funding dries up
- Malpractice concerns and lawsuits are preventing a wider acceptance in the medical society
- Confidentiality of patient information
- Lack of substantial Medicare and Medicaid reimbursement

As in any typical decisional evaluation we then need to compare the advantages and disadvantages based on the analysis of Markets Restraints and Markets drivers, as described above. This comparison will help us in understanding what in reality is driving the adoption of a telemedicine program.

On one side of the equation we need to consider the cost associated with the purchase of the equipments, the cost associated with training and maintenance and the operational cost.

On the other side we need to compare it with the benefit of the EQUITY OF CARE, an important concept that means: everyone, regardless of their physical location, can receive the same level of care as for the patients located near by specialty hospitals.

The availability of clinical medical facility far from the specialty hospital brings in another concept: the SCREENING of PATIENTS. This is the capability of the remote center to provide an early clinical assessment prior to the patient being sent for specialty assessment to the specialty hospital. Doing so we are able, not only to reduce the amount of patients traveling but also we are able to build a competence center on the remote location. This means: *Transfer of Competence, decreased travel cost and, more important, distribution of risk and responsibilities.*

VI. TELEMEDICINE PROGRAMS

- **Himalaya Expedition**
  Cho Oyu (8201 m) and Shishapangma (8027m). Extreme telemedicine support in the filed of: Spirometry, Stethoscope and ECG auscultation and recording in high performing environment

- **Unimed Ultrasound, St. Olav's Hospital (**University Hospital) and the Medical Faculty at NTNU (Norwegian University for Science and Technology), all located in Trondheim, Norway Their research activity focuses on

methods and technology for minimally invasive image guided therapy. The main intraoperative imaging modality is ultrasound. Their goal is safer, more accurate and less invasive surgical procedures.

- **Emirates Hospital, United Arab Emirates**: Visual communication makes it possible to connect with experts abroad and exchange x-rays, MRI, and CT scanes with highly accurate remote diagnosis and knowledge-sharing with hospitals regionally and globally.

- **Bichat Hospital, France:** 10 French hospitals have installed Visual Communication to links their emergency rooms to the stroke center at Bichat Hospital. Visual communication has helped decreased the time of diagnoses with speedier treatment of emergency stroke cases, less chance of death or permanent impairment for victims.

VII. OPEN STANDARDS

The great challenge for the hospital's management is to define a balanced way of supporting their patients as well allowing their physicians to perform their duties in the best possible way. The typical question would then be:

- How can I provide fully interactive support to my community?
- How to use at the best the fewer available resources in our Hospital?

An proven and affordable technology has today filled the gap of an expensive and complex solution available few years ago. Today open standard and open connectivity is a key factor when adopting new technology in the hospital environment. Almost all manufacturers today have solutions providing video capability but fewer has the possibility of providing a very compelling and robust end-to-end solution

The Future is represented by building blocks elements that can be easy combined for the Total Open solution.

Most of the past challenges were represented by the Technical interoperability while today we are at the stage were we need to look at different and more complex requirements. Legal Jurisdiction, liability, taxation, confidentiality of the data are among the compelling ones.

VIII. CONCLUSION

The visual communication in to the Hospital environment is the base platform of a successful telemedicine programs and the most efficient way of communicating internally and externally. A successful implementation programs does not simply happen by accident. It is the result of thoughtful planning, skillful management, adequate funding and the dedication of participating professionals. It is reflecting a commitment to teamwork to combine technical and operational complexities into a fully integrated and efficiently functioning program. Video has become the number one tool to increase the efficiency of daily and administrative routines with a considerable improvement of continuative medical training and clinical support.
The technology today has to be transparent and needs to be clearly accessible. This is why we have committed to reliability, high-quality, scalable and secure video solutions.

Reinforcement of Transtheoretical Model on Exercise Behavior using Radio Frequency Identification Technology

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Abstract- While chronic diseases increasingly cause major health problems in industrialized countries, physiology shows that regular moderate exercise can improve health and physical fitness. The phenomena indicate that the task of modifying individual exercise behavior is still a big challenge, although the benefits of exercise are well-known. Many studies report that 50% of participants may drop out of an exercise program within the first few months, and conclude that a longer duration is required for exercise behavior change. According to the trans-theoretical model, it is crucial to provide all relevant records and information during the pre-contemplation and contemplation stages for any exercise behavior change program. Beside these two basic requirements, labor-saving and time-flexible properties are also required for modern exercise management. This paper illustrates the principle and implementation of an information system based on RFID (radio frequency identification) technology, in attempting to resolve the difficulties encountered in implementing exercise behavior change programs. With this system, participants can acquire information on exercise (running time, speed, frequency etc.) and fitness change through the Internet or email, either actively or passively. In addition, induced personal interest data, statistics, and recommended exercise prescriptions are also provided. A survey shows that this strategy attracts college students' interest. Its effectiveness in regulating their activity as runners can be further studied.

Keywords: Transtheoretical model, Behavioral Change, Radio frequency identification

I. INTRODUCTION

In the declaration of Alma-Ata of 1978 the WHO (World Health Organization) emphasized the provision of primary health care as the main means to improve popular health[1]. Within a decade, in 1986, the first World Health Promotion Conference had been held and the Ottawa Charter was drawn up, which defined "health promotion" as the process of enabling people to increase control over and improve their health[2]. In other words, the concept of health had radically changed in the course of this decade. A healthy person now means "a person who lives actively" rather than "a person without illness".

It's a well-documented and obvious fact that regular moderate exercise improves a person's faculties, sensitivity, and organizational ability, both physically and spiritually[3,4,5]. However, the sedentary lifestyle has become the main living style in modern industrialized countries. The lack of physical activity causes the increasing incidence of chronic diseases such as cardiovascular diseases, hypertension, and cancer. More seriously, the age of occurrence of these diseases is decreasing.

In response to this phenomenon, a number of countries have begun to propose health promoting polices which would encourage youngsters, adolescents, or adults to join various kinds of activities, and ultimately to get into the habit of regular exercise in order to lessen the health problems due to inactivity. Unfortunately, studies show that up to 50% of participants may quit from such programs within the first three months[6]. Maintaining the commitment of participants to their exercise programs is still a challenge nowadays.

Numerous theories have been proposed for modeling and figuring out the process required for behavior change. Among them, the **T**ranstheoretical **M**odel(**TM**) is one of the most widely-applicable theories with regard to promoting regular exercise. In this study, TM is used as the basis for system design. The participants, all of whom are college students, are categorized according to TM's conceptual stages based on their answers recorded in a questionnaire. Participants in selected stages are urged to exercise (jog or walk) on a track which is equipped with a **R**adio **F**requency **Id**entification (**RFID)** system. The records of individuals or groups are processed and presented by computer systems. In addition to the exercise records, discussion boards and miscellaneous information are provided.

The main goal of this paper is to present the design and implementation aspect of new technologies (RFID, internet, email) that are widely accepted by adolescents.

II. BACKGROUND

A. Transtheoretical Model

The **T**ranstheoretical **M**odel (**TM**) was developed by Dr. Prochaska and his colleagues. It has been operationalized and used extensively to promote optimal health by promoting behavioral change in areas such as smoking, diet, alcohol and substance abuse, eating disorders, panic disorders and others. One of the model's major contributions is the recognition that behavioral change unfolds through a series of stages[7]. The stages of change are better described as spiraling or cyclical rather than linear. In this model, people go through different processes of change as they move from one stage of change to another. According to this theory, tailoring interventions to match a person's readiness or stage of change is essential.

TM has been applied in the field of regular exercise behavior by Marcus et al[8] and then specifically applied to adolescents by Claudio et al[9]. The processes of change referred to in these studies are summarized in Table 1.

TABLE 1 PROCESSES OF CHANGE

Process	Definition
Experiential	
Consciousness raising	Efforts by the individual to seek new information and to gain understanding and feedback about the problem behavior
Dramatic relief	Affective aspects of change, often involving intense emotional experiences related to the problem behavior
Environmental reevaluation	Consideration and assessment by the individual of how the problem affects the physical and social environments
Self-reevaluation	Emotional and cognitive reappraisal of values by the individual with respect to the problem behavior
Social liberation	Awareness, availability and acceptance by the individual of alternative, problem-free lifestyles in society
Environmental	
Counter condition	Substitution of alternative behaviors for the problem behavior
Helping relationships	Trusting, accepting, and using the support of caring others during attempts to change the problem behavior
Reinforcement management	Changing the contingencies that control or maintain the problem behavior
Self-liberation	The individual's choice and commitment to change the problem behavior, including the belief that one can change
Stimulus control	Control of situations and other causes which trigger the problem behavior

Though the latter study concluded that adolescents use the processes of change in a similar fashion as middle-aged individuals, there is one enormous difference between these two groups which is ignored in this study. It is an important fact that adolescents accept and utilize new technology more widely and readily than middle-aged individuals.

There are currently few studies dealing with the effects of technology processes on behavior change in adolescents who are more familiar with new technologies than adults.

B. RFID

RFID stands for **R**adio **F**requency **Id**entification and has been available to the sports industry for over ten years. While numerous manufacturers utilize this technology in sports timing, none or very few schools use it in exercise behavior measurement for students. The advantage of RFID is not only that it does not require direct contact or line-of-sight scanning but also that a moving transponder can be read. The RFID system used in this research consists of three components: an antenna, a reader, and a transponder (the tag). The antenna uses radio frequency waves to transmit a signal that activates the transponder. When activated, the tag transmits data (identification of the tag) back to the antenna and this is then received by the reader. Different applications require different RFID technologies. In this system, the low-frequency RFID system is adequate for acquiring information on running.

III. SYSTEM ORGANIZATION AND ARCHITECTURE

The system consists of three layers as shown in Fig. 1. The top layer is the presentation layer which presents the running records and physical condition individually or in a group. The middle layer is the processing layer which processes acquired data and identifications sensed by RFID system. The bottom layer is the acquisition layer which acquires tag identification when a participant is running and information on the participant's individual physical condition (fitness, BMI, etc) periodically.

The web page in the presentation layer consists of all data and information induced from the processing layer. The structure of the web page is shown in Fig. 2. The email function in the presentation layer can send individual and group messages, records, etc. to participants periodically.

The main task of the processing layer is to process the running record file daily, and then aggregate the data into the database. In addition to the running record processing, the individual physical condition is also aggregated when it is obtained from the acquisition layer.

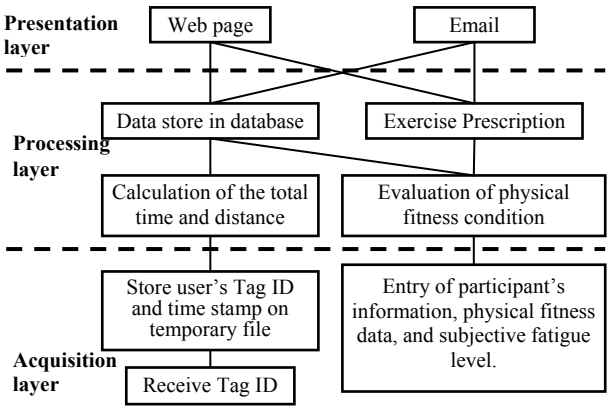

Figure 1. The System Organization.

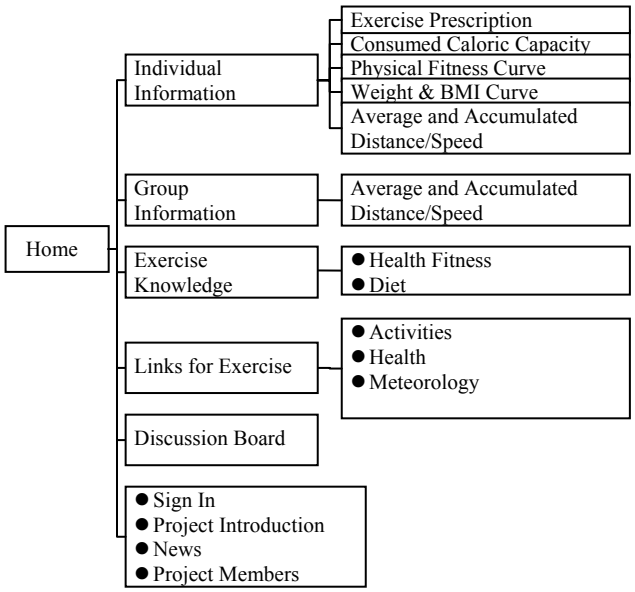

Figure 2. The Web Page Organization.

The acquisition layer consists of two RFID systems, a wireless communication system, and web pages for personal information, physical condition data, and miscellaneous data entry. The RFID systems are installed in the sports track to acquire the identification of individuals, as shown in Fig. 3. Each time an identification is acquired, it is transmitted to the server immediately via the wireless communication system. The identification is then tagged with the system clock and stored in a temporary file. At midnight of each day, the temporary file is processed by the processing layer.

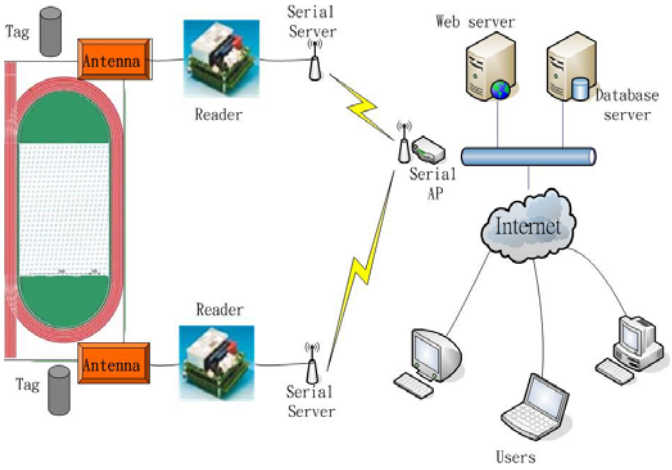

Figure 3. The System Architecture.

Since the running record can be collected at any time, this system provides flexibility of exercise time for participants in addition to the labor-saving advantage for exercise measurement.

Some advertising activities are held to initiate the operation of the system and measure the change of the physical condition of participants. The TM's processes of change are expected to be reinforced by the system's functions and/or those advertising activities. Since the system functions and advertising activity are related so closely, it is difficult to isolate one's effect from the other's effect on the TM's processes. Table 2 lists the possible reinforcement of system functions and advertising activities on TM's processes of change.

TABLE 2 POSSIBLE REINFORCEMENT ON PROCESSES OF CHANGE

Process	System Functions / Advertising Activities	Possible Effectiveness
Experiential		
Consciousness raising	1. Web pages of exercise knowledge 2. Links for exercises 3. Advertising post*	-Participants may understand the relationships between exercise and physical fitness(health) - Participants may notice the advantages of exercise and disadvantages of inactivity - Participants may know the principles of physical fitness training
Dramatic relief	1. Weekly e-mail	- Participants may notice the exercise progress and condition weekly
Environmental reevaluation	1. Group Achievement in running Record	-Peer pressure
Self-reevaluation	1. Individual exercise and physical fitness records 2. Periodic physical fitness testing*	- Participants may notice the physical progress through exercise record
Social liberation	1. Annual mandatory 10km cross-country race	- Participants may train themselves for passing the race within 70min.
Environmental		
Counter condition	N/A	N/A
Helping relationships	1. Discussion board	-Participants may share and learn experience from each other
Reinforcement management	1. Award for high participation*	-Participants may pick their convenient time
Self-liberation	1. sign the consent letter for regular exercise(at least 10min.x 3 days per week)*	- Participants may promise self-regulating
Stimulus control	N/A	N/A

* Advertising Activity

IV. POPULATION AND METHOD OF QUESTIONNAIRE

One hundred randomly selected sophomores were invited to participate this study because they had already taken the standard physical education course for two semesters.

Each participant was asked to complete a measurement of physical condition and a questionnaire before he (or she) proceeded to use the system. In the questionnaire, family disease history, present and past exercise behavior, exercise barriers, knowledge, self efficacy and health-related behaviors are evaluated. The measurement of physical condition includes body weight, fat composition, and overall physical fitness. The measurements are used as baseline data for final evaluation of this project when it is finished. Each time a participant accesses the web page, s/he is asked to report degree of fatigue and subjective reaction with regard to the latest run.

V. FUTURE WORKS

The system is completed and presently under testing. In a few months another questionnaire will be used to evaluate the effectiveness of this system in promoting regular exercise behavior.

The experience of this study is expected to give information on several levels of influences on exercise behavior, including: intrapersonal factors, interpersonal and group factors, institutional factors, community factors, and public policy.

ACKNOWLEDGMENT

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Progress of e-Health in Australia: Health*Connect*

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***Abstract*- Health*Connect*, a Health Information Network for all Australians, is the National e-Health model. It is a joint Australian, State and Territory Governments initiative. This paper presents a short report on Health*Connect* and it attempts to cover Health*Connect* trials throughout Australia. Some contents of this paper were presented at the public seminar "Progress of e-Health in Australia: 20 years of achievement", for the Health Informatics Society of Australia (HISA), at the Western Australian Department of Health, East Perth (WA).**

***Keywords*- EHR, e-Health, Medi*Connect*, Health*Connect*, EHR*net, openEHR, CHORd, HC-CIP, Provider*Connect*, National Health Privacy Code, EAN, ACOM.**

INTRODUCTION

Providing healthcare services to its citizens is government's responsibility. Healthcare is an institution that meets some of society's most critical needs and any member of society sometime or other may avail these services. ICT (Information and Communication Technology) provides the necessary infrastructure and software tools to make connectivity between all healthcare providers effective, thereby moving the concept of 'Health' to 'e-Health'.

Health*Connect*, a Health Information Network for all Australians, is the National e-Health model. It is a joint Australian, State and Territory Governments initiative. This paper presents a short report on Health*Connect* and it attempts to cover Health*Connect* trials throughout Australia.

THE HEALTH*CONNECT* TIME LINE

Table 1 below describes the entire timeline for the Health*Connect* project:

TABLE 1
THE HEALTH*CONNECT* TIMELINE

Jun.	1993	The National Health Information Agreement (NHIA) has enabled the development of other important elements of the National Health Information Infrastructure: - the National Health Information Work Program (NHIWP) - the National Health Data Dictionary (NHDD) - the National Health Information Management Group (NHIMG)	[1]
Nov.	1999	Establishment of National Electronic Health Records Taskforce	[2]
Jul.	2000	Commencement of Medi*Connect* for consumer medication, formerly BMMS (Better Medical Management System)	[3]
Nov.	2000	Agreement for funding R&D of Health*Connect* for 2 years by Health Ministers	[4]
Sep.	2001	Establishment of Health*Connect* Stakeholder Reference Group	[5]
Sep.	2001	The Health*Connect* board approved the development of a Business Architecture for Health*Connect*	[2]
Apr.	2002	Released Health*Connect* Business Architecture for Comments	[3]
Oct.	2002	Commencement of Phase 1 of Health*Connect*, to continue until February 2004	[6]
Oct.	2002	Commencement of Health*Connect* trials in Northern Territory and Tasmania	[6]
Oct.	2002	EHR*net, a New South Wales initiative as part of Health*Connect* trials	[6]
Oct.	2002	Phase 1 of Health*Connect* Clinical Information Project (HC-CIP) in South Australia, a framework for defining clinical information capture [in the form of 'event summaries' and representation (lists, views, and reports)] in shared EHR, from October 2002 to February 2004	[7]
	2002	Provider*Connect*, a National Health Provider directory framework by Western Australia for Health*Connect*	[6]
Jan.	2003	Integration of Medi*Connect* into broader Health*Connect* Agenda	[8]
Feb.	2003	EAN as the product standards for medicines for Australian Catalogue of Medicines (ACOM) [endorsed by Standards Australia International's Health Informatics Committee]	[9]
Feb.	2003	Launch of Health*Connect*'s Consumer On-line access in Tasmania, consumer can check their EHR on-line	[10]

Mar.	2003	The Health*Connect* board endorsed the Health*Connect* Business Architecture Version 1	[7]
Mar.	2003	Announcement of Medi*Connect* field tests in Launceston and Ballart	[11]
Jul.	2003	Health*Connect* Project Review and Stakeholder feedback; Planning for 2nd phase	[12]
	2003	Health*Connect* trial at Victoria; the Community Hospital Online Record (CHORd) project, an electronic patient-centered record	[13]
Sep.	2003	Released Health*Connect* Interim Research Report and Draft System Architecture for comments	[13]
Dec.	2003	Commencement of Health*Connect* trials in North Queensland	[12]
Dec.	2003	Department of Health and Ageing signs a contract with EAN Australia to build and host Central Database for Medicines Information [a catalogue called Australian Catalogue of Medicines (ACOM)]	[14]
Feb.	2004	Phase 2 of HC-CIP, from February 2004 to June 2004	[15]
Mar.	2004	The Australian Government announced Health*Connect* is to be implemented nationally	[16]
May	2004	Launch of Health e-link (previously known as EHR*net) at Westmead in New South Wales	[17]
Jun.	2004	Phase 2 of Medi*Connect*, field tests at Launceston and Ballart	[13]
Jul.	2004	Establishment of National e-Health Transition Authority (NEHTA) [for 12 months work program]	[18]
Aug.	2004	National Health Privacy Code proposed by the National Health Privacy Group	[19]
Nov.	2004	Released Health*Connect* Business Architecture version 1.9 for comments	[20]
Nov.	2004	Completion of Evaluation of Medi*Connect* Field testing	[21]
Dec.	2004	Medi*Connect* formally ceased as a stand-alone system; Participants involved with Health*Connect*	[21]
Dec.	2004	National Health Information summit at Melbourne for knowing more about Health*Connect* and IM&ICT scene in Australia	[17]
Jun.	2005	Department of Health and Ageing released Health*Connect* Implementation Strategy version 2.0, a road map for Health*Connect*	[22]
	2005	First implementation of Proposed National Health Privacy Code at Tasmania, South Australia and the Northern Territory expected from July 2005	[23]

Note: Reference number has been provided for each event on the right-hand side of the table, please refer the reference section for the corresponding number.

A BRIEF DESCRIPTION OF HEALTH*CONNECT* PROJECT

C. *What is* Health*Connect?* [20]

- Health*Connect* is a National system of electronic health records that aims to improve the flow of information across the Australian health sector. It is a cooperative venture between the Australian, State and Territory Governments.
- Health-related information about a person will be collected in a standard format at the point of care, such as at a hospital or a general practitioner's (GP's) surgery.
- Health records are collected, safely stored and exchanged within strict privacy safeguards.
- Information can then be retrieved whenever it is needed and exchanged via a secure network between authorised health care providers.
- Process can only happen with the individual consumer's permission.
- Participation is voluntary for both consumers and health care providers and they can choose to withdraw at any time.
- Event summary information will be held as close as practicable to the point of care.
- Some event summaries, such as prescriptions, may be held in a single separate facility to aid rapid access.

D. *Benefits of* Health*Connect to Consumers* [20]

- Offers significant control over who has access to their personal health information and how is that information being used.
- Can recall details of their medical history each time they see a different health care provider.
- Participation is opt-in opt-out type.

E. *Benefits of* Health*Connect to Service providers* [20]

- Will provide important information about a consumer's medical history at the point of decision-making.
- Enables building a better evidence base for health care delivery.
- Participation is opt-in opt-out type.

F. *Benefits of* Health*Connect to Other communities* [20]

- Will help to improve the safety, quality, effectiveness and efficiency of the Australian health care system.
- Researchers will be able to establish a more comprehensive picture of Australians' health.
- Will enable governments to make better decisions about health issues in the future.

G. *Challenges of* Health*Connect* [20]

- Moving from paper based health records to EHR.
- Gather scattered information and develop better organised/structured information.
- Manage incompatible databases and standards to interoperable ones.
- Enable to focus on direct care.
- Making EHRs nationally available.
- Following nationally acceptable privacy regulations.

KEY SECTIONS OF HEALTH*CONNECT* BUSINESS ARCHITECTURE VERSION 1.9

Ref. [20] Fig. 1 to Fig. 7 below, are the key sections of Health*Connect* project:

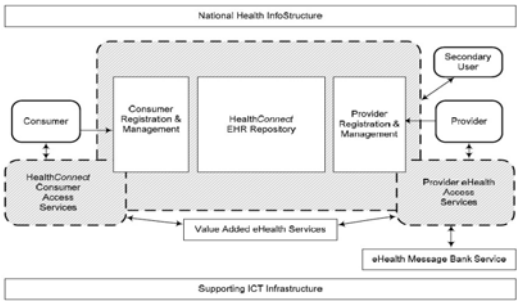

Figure 1. Key Health*Connect* Roles and Services *(pg. 39)*.

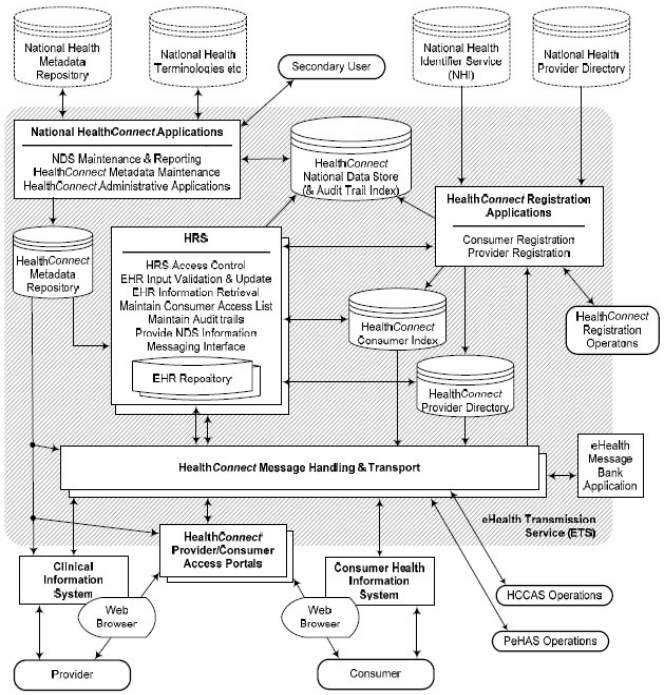

Figure 2. Health*Connect* Systems Overview *(pg. 154)*.

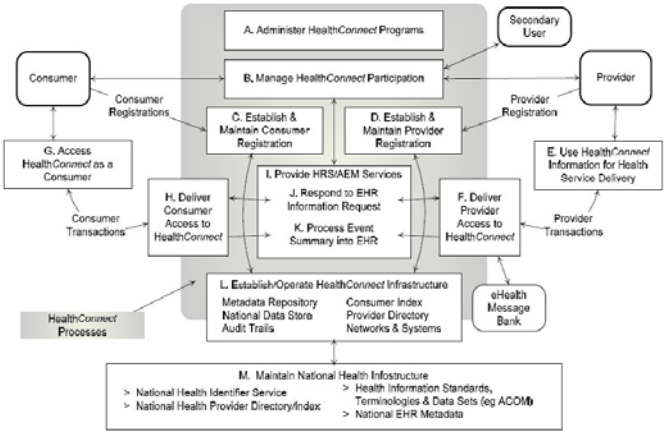

Figure 3. Health*Connect* Process Map *(pg. 148)*.

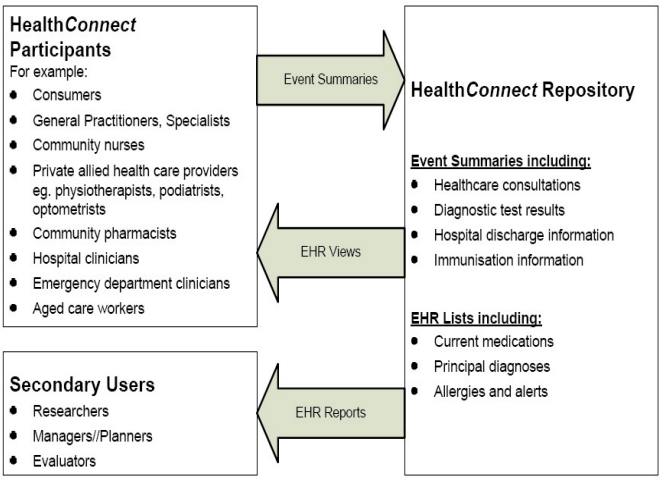

Figure 4. Key components of Health*Connect (pg. 25)*.

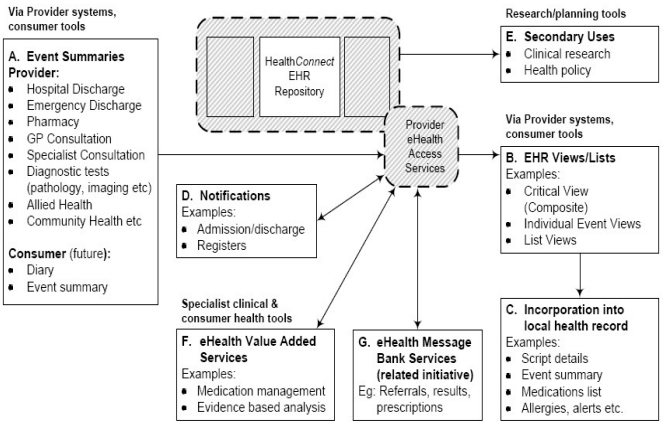

Figure 5. Key Health*Connect* Functions and Interactions *(pg. 43)*.

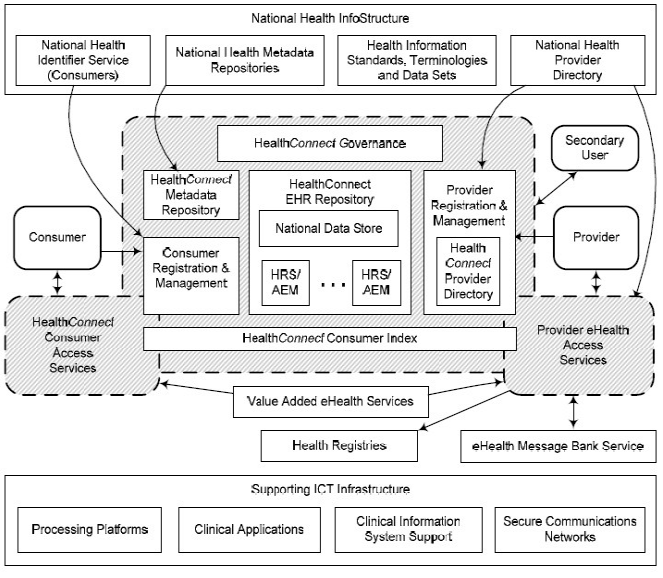

Figure 6. Role Map for Delivery of Health*Connect* Services *(pg. 104)*.

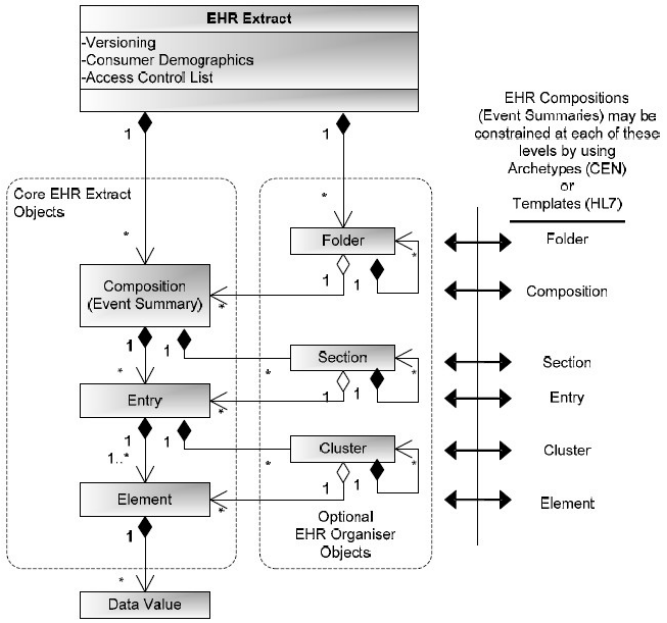

Figure 7. Simplified CEN EN 13606-1 Reference Model *(pg. 130)*.

HEALTH*CONNECT* TRIALS THROUGHOUT AUSTRALIA

A. Medi*Connect field tests at Ballart and Launceston* [7]

- Formerly known as the Better Medication Management System (BMMS).
- A secure national electronic system drawing together medication records held by different doctors, pharmacies and hospitals.
- Gives doctors and pharmacists complete information about the medicines people use, so they can improve quality and safety in the management of medications.
- Will form the medicine component of Health*Connect*.
- Each year some 140,000 Australians are admitted to hospital because of problems associated with the use of medicines. The cost of this to the public hospital alone is estimated at $380 million.
- Doctors and pharmacists taking part in the Field Test will recruit consumers to join Medi*Connect*, particularly encouraging older people and people having high and complex medication needs, as these people are likely to benefit most by participating in Medi*Connect*.
- Support for MediConnect at Ballarat- the District Division of General Practice and Pharmaceutical Society of Australia and Pharmacy Guild of Australia.
- Support for MediConnect at Launceston- the local Division of General Practice, GP North, Pharmaceutical Society of Australia and Pharmacy Guild of Australia.
- Toward the central database for medicines information, EAN has been adopted as the product standards for medicines for ACOM (the Australian catalogue of medicines).

B. Health*Connect trial at Tasmania (Clarence, Hobart suburbs)* [24]

- Size of Tasmania makes a statewide implementation manageable and their existing involvement with Health*Connect* and Medi*Connect*.
- An estimated 1800 diabetes patients at Clarence municipality.
- Clarence hosts an array of healthcare providers proficient in using IT applications.
- Participants: General practitioners, Pathology laboratories, and Royal Hobart hospital.
- Preliminary trial involves-
  - ✓ Testing communication process among the participants;
  - ✓ How information can be recorded, how it can be extracted and how some of the information can be put on a secured storage site; and
  - ✓ How others can extract information and proceed with patient care.
- Health service providers will populate the storage with health summaries by an individual's consent.
- Authorised Healthcare providers involved in the care of people with diabetes will be able to access the storage during subsequent consultations.
- SSL (Secured Socket Layer) for web traffic and PKI (Public Key Infrastructure) for messaging to guarantee privacy and security.
- The Tasmanian Health*Connect* Trial Management Committee oversees the trials.

C. Health*Connect trial at Northern Territory (Katherine region)* [24]

- Highly mobile population spread across 160,000 sq km.
- Communities can get isolated during seasonal floods.
- Current Medical Information Systems Software's are unable to communicate, forcing doctors to rely on traditional means like phone, fax, etc.
- Currently health related information of an individual is accessible only after completion of consultation.
- Health*Connect* to provide timely vital health information to healthcare providers.
- Participants: Katherine West Health Board, Wurli Wurlinjang Health Service, Katherine District Hospital, Department of Health and Community Services clinics, and other health service providers.
- Wurli Wurlinjang Health Service houses secure, community-based Health*Connect* storage.
- Storage to be populated by summaries (pathology reports, hospital discharge summaries, medical summaries, and specialist clinic and theatre bookings) by health service providers with an individual's consent.
- Authorised Healthcare providers will be able to access the storage with an individual's consent.
- Archiving done using ARGUS, a software product developed by the Top End Division of General Practice, which allows exchange of information via e-mail using PKI.
- A Governance Committee comprising representatives from key stakeholder groups oversees the trials.

D. Health*Connect trial at New South Wales (Hunter area and Greater Western Sydney area)* [6]

- Two NSW lead Implementation sites (along with sites in Queensland)-

  - ✓ The Chronic Disease Management System in the Hunter area; and
  - ✓ The Child Health Information Network in the Greater Western Sydney area.
- Trials are part of NSW (New South Wales) initiative EHR*net and contributing towards Health*Connect* Systems Architecture, to ensure consistency between the NSW and national initiatives.
- Workshops held between representatives from 5 NSW Health Services, NSW Health Department, GP practice representatives, consumers, and other stakeholders to review their clinical and business requirements using a series of case studies and scenarios.
- The Chronic Disease Management Group had particular focus on patients with congestive heart failure and chronic obstructive pulmonary disease and how *information flow* from Health*Connect* can take care of these complex care needs requiring access to multiple services across acute and community settings.
- The Greater Western Sydney Child Health Information Network (CHIN) has developed information requirements for Health*Connect* for paediatrics and child health and is very similar to those of chronic disease. This information is needed to support decision-making at the point of care and for improving access to parental support and education.
- Subsequent EHR*net implementation is staged to be in Maitland/Raymond Terrace region.
- The EHR*net program now names as e-Link program was launched at the Children's Hospital at Westmead.

E. Provider*Connect for* Health*Connect from Western Australia* [6]

- Developing a national provider directory framework jointly funded by the Western Australian Department of Health and the Commonwealth, through the Health*Connect*.
- Current directories of approved healthcare providers used by both public and private health services are-
  - ✓ Both disparate and unconnected;
  - ✓ Available in limited forms such as hard copy; and
  - ✓ Not available to key information stakeholders (such as GPs)
- HIC (Health Insurance Commission) to contribute to this national strategy by undertaking business and technical analysis of its directory infrastructure for connecting/integrating them with broader health sector.
- The national strategy includes identification of legislative and policy issues.
- Provider*Connect* will take into account the range of existing provider directory projects and systems around the country and investigate the international trends.
- Provider*Connect*'s standard for healthcare provider identification is a joint initiative of Standards Australia's Health Informatics Committee and the National Health Data Committee.
- Provider*Connect* is also known as National Provider Directory.

F. Health*Connect trial at Queensland (Townsville and Brisbane)* [25]

- For patients living in rural areas, significant planning is often required before visiting a GP. This becomes more important when someone requires major surgery, which is often available in large regional hospital.
- In North Queensland 40% of patients living in rural remote areas undergo surgery at the Townsville General Hospital.
- Through Health*Connect*, the patients GP will provide information to the specialist/surgeon at Townsville and after surgery, key information required for post-operative care will be made available to those involved in patient's care.
- The National Health and Development GP Integration project 'Brisbane South Diabetes Service' is a 'one stop shop' service for diabetes patients, giving them access to range of services.
- Diabetes is a chronic disease affecting an estimated 4.3% of the adult population.
- Previous efforts across all healthcare sectors have led to development of a standard care pathway for diabetes, collaboratively produced by Queensland Health and the Queensland General Practice Advisory Council and subsequently endorsed by the Royal Australian College of General Practitioners.
- Through Health*Connect*, Australian consortiums are developing a possible Health*Connect* record Architecture, *open*EHR, a standard approach for recording health records electronically and, it is being developed by the Distributed Systems Technology Centre (DSTC).
- *open*EHR aims to provide an open architecture and standard format for electronic health records and a common framework for structuring, storing and managing patient data so that it can be shared and exchanged between different healthcare providers in a safe and secure manner.

G. Health*Connect trial at Victoria (Bayside Health)* [13]

- The Community Hospital Online Record (CHORd) project between Health*Connect* Program Office based in the Australian Department of Health and Ageing and the Victorian Department of Human Services (DHS).
- Bayside Health, a Metropolitan Health Service, the governance grouping of three healthcare facilities- the Alfred, Caulfield General Medical Centre, and Sandringham & District Memorial Hospital.
- The CHORd project aims to progressively implement an electronic patient-centered record for a selected group of chronically ill, frail, elderly patients requiring shared care from a number of providers across different service and organizational boundaries.
- In the longer-term, the Australian Government will negotiate with Victoria and provide funding support to fully establish the CHORd project as a Victorian Health*Connect* trial.
- Canberra based Health*Connect* Program Office to assist Victoria in the development of evaluation, design, consent and privacy policies and communication

strategies – and facilitate linkage between the CHORd project and other Health*Connect* trials.

- Phase 1 will target consumers enrolled in the Hospital Admission Risk project (HARP) Better Care for Older People and Disease Management Unit programs.
- Having established a working system within the hospital and allied community service providers, Phases 2 & 3 will involve further expansion of interfaces between information systems including pathology and radiology information and interoperability with information systems operated by community-based organizations, such as the Royal District Nursing Service.

H. Health*Connect trial at South Australia (Clinical Information Project [HC-CIP])* [7]

- Developing a framework for defining clinical information capture (in the form of 'event summaries' and representation (lists, views and reports) in shared EHRs.
- Developing prototype event summaries, lists, views and reports in collaboration with the Health*Connect* trial sites and priorities for the broader Health*Connect* agenda.
- Developing a specification for a national hospital discharge summary for:
  - ✓ General application (requirements for communication between hospitals and providers); and
  - ✓ Long term shared EHR (i.e. one of the Health*Connect* 'event summaries').
- The initial health profile, GP consultation, hospital discharge summary, pathology, and imaging event summaries were identified as immediate priorities, with the hospital discharge summary being eagerly awaited by clinicians.

I. Health*Connect implementation plan* [12]

Table 2 below describes 2-phase implementation plan of Health*Connect*.

TABLE 2
THE HEALTH*CONNECT* TIMELINE

Research & Development Phase (2001 to 2003)	Design & Development Phase (2003 to 2005)
▪ Was largely centered on answering a set of key research questions intended to gauge the potential of Health*Connect* to be developed as a National system. ▪ Achievements in the area of Design & Implementation: ✓ Completion of the first version of the Business Architecture, which details processes for how consumers and providers interact with Health*Connect*; and ✓ Completion of the first draft of the Systems Architecture, which provides the technical blueprint for how Health*Connect* could be implemented nationally.	▪ Will concentrate on the actual design and development of core Health*Connect* components and other essential preparatory development activities needed ahead of proceeding to implementation beyond 2005. ▪ Objectives of 2nd phase are to: ✓ Demonstrate the value and feasibility of Health*Connect* through further trials and evaluation; ✓ Develop a robust business case for proceeding with National implementation; ✓ Finalise the Health*Connect* design; ✓ Deliver selective Health*Connect* system components; ✓ Commence a process of National integration of Health*Connect* with Medi*Connect* and other electronic health record architectures; ✓ Continue development of e-health building blocks essential for electronic health record architectures; ✓ Ensure stakeholders are informed about and are ready for Health*Connect*; and ✓ Develop a National implementation plan for Health*Connect*.

CONCLUSION

This paper presents a short report on Health*Connect*, the Australian e-Health model. The report is comprehensively packed, covering Health*Connect* trials throughout Australia.

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The author would like to thank the members of the Centre for Health Informatics Research of Curtin University of Technology, Perth (Australia) for the support provided during the author's short-term period of stay there as 'Adjunct Research Fellow'.

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SSM Literature Review

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***Abstract*- Soft Systems Methodology (SSM, Checkland, late 1970's), a socio-technical tool, has found a place in dealing with many complex situations, but is relatively unknown in the Health Sector. Aimed to find whether there lies any potential for using SSM in Health Business Environments, an extensive literature review was carried out at CHIR (Centre for Health Informatics Research, Curtin University of Technology) on the use of SSM resulting in a collection of publicly available documents spanned for about two decades. This paper, based on the publicly available literature, attempts to provide a picture on the worldwide use of SSM with specific reference to Public Sector and Health Sector. This is the first paper among a series of two papers; and the findings were put forward for the focus group discussion "Soft Systems Methodology for achieving successful technological adoption outcomes- History & Future" at the School of Public Health, Curtin University of Technology, Perth (WA).**

***Keywords*- Soft Systems Methodology, SSM.**

INTRODUCTION

Systems deemed technologically sound and economically obtainable have often not delivered as envisaged, as primarily organisations find changing their complex business systems and culture too hard.

Ref. [1] Soft Systems Methodology (SSM, Checkland, late 1970's), a socio-technical tool, has found a place in dealing with many complex situations, but is relatively unknown in the Health Sector.

Providing healthcare services to its citizens is government's responsibility. So, it is basically viewed as a public service. Health Sector is a complex area involving massive information, people and technology. Moreover, the complexity increases exponentially while safeguarding people's ever increasing personal information under various sections of privacy laws, combined with accepted code of work ethics during practice. Hence, efficient and effective outcomes can only be achieved by addressing human aspects of organizational activities and processes.

SSM has been used in Australia but is less known in Health Sector. An extensive literature review was carried out on the use of SSM resulting in a collection of publicly available documents spanned for about two decades. From which, an interesting picture has emerged on the worldwide use of SSM in various areas including the Public Sector and the Health Sector.

DATA COLLECTION

H. Source

Entire publicly available SSM related data was collected from *CiteSeer.IST* Scientific Literature Digital Library (http://citeseer.ist.psu.edu/) and *Google*, the most commonly used powerful web search engine (www.google.com/ncr).

I. Keywords

Keyword employed for searching data were- SSM, Soft Systems Methodology, Soft Systems Approach, Soft Systems, and Soft Approach.

J. Relevance

Published papers, technical write-ups, project reports, MS/PhD theses, and selective chapters of books published as papers were considered relevant. While, extended abstracts, course material of short-term courses, academic lecture handouts, notes of talk/presentation given by guest speakers, and bibliographies were excluded.

K. Allied areas

While searching data using above keywords, few documents connected to General Systems Theory, Viable Systems Model, Systems Approach, Systems Behaviour, Action Research, Multiple Perspectives, Socio-Cultural, Human Computer Interface, etc. fields were also obtained. Though these fields are not pure SSM, they contain some aspects of SSM and some of them are predecessors of SSM. Again, only relevant documents were retained and they were grouped under SSM allied areas. But, no separate efforts were made to collect data related to allied areas.

DATA ORGANISATION

A. Storage format

All the documents collected were converted into PDF (portable document format) files as they can be read on multiple platforms. The naming convention for the documents followed was *xnna-a.pdf* where: *x* - denotes last name of first author, *nn* - the year of publication and *a-a* - keyword(s) obtained from the document.

An excel spread sheet was made describing document filename, full title of the document and it's author(s), year of publication, category to which the document belongs, additional information of the document, country tag, and

additional tag. This spread sheet is used for searching documents, sorting them, generating statistics, etc.

B. *Categories*

Each document was grouped under one of the 8 different categories based on the area that it is addressing:

- Education Sector
- Enterprise Resource Planning
- Generic
- Health Sector
- Knowledge Management
- Model Development
- Requirements Engineering
- Systems Development

C. *Country tags*

Internet country domain codes (e.g. uk = United Kingdom, au = Australia, dk = Denmark, etc) were used to identify the place where the work described in the document was done.

D. *Additional tags*

Additional tags were used to describe whether the document talks about application in public sector, or belongs to SSM allied area, or both an SSM allied area applied in public sector.

E. *Library*

This entire activity has resulted in a small collection of SSM literature that is currently available with CHIR.

FINDINGS & INFERENCES

All figures mentioned in square brackets and yellow in colour are from Australia.
A small picture of the Australian national flag is placed next to the domains that are addressed by SSM in Australia.

A. *Various domains addressed by SSM*

Fig. 1 below displays various domains addressed by SSM.

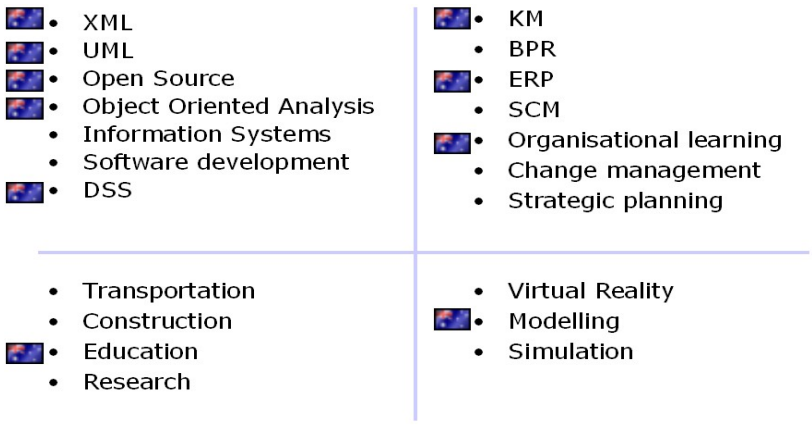

Figure 1. Various domains addressed by SSM.

B. *Distribution – Year wise*

Fig. 2 below shows year wise distribution of SSM documents.

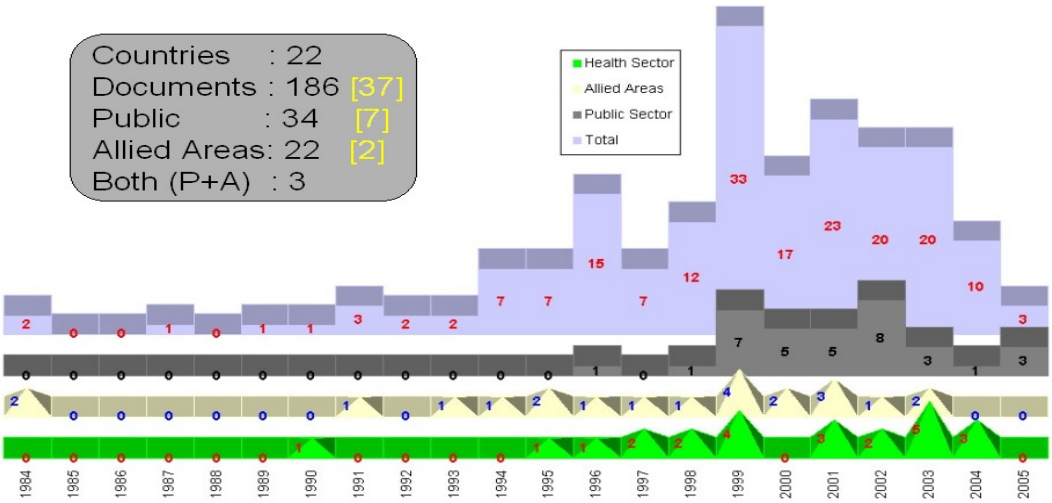

Figure 2. Distribution – Year wise.

C. Distribution – Country wise

Fig. 3 below shows country wise distribution of SSM documents.

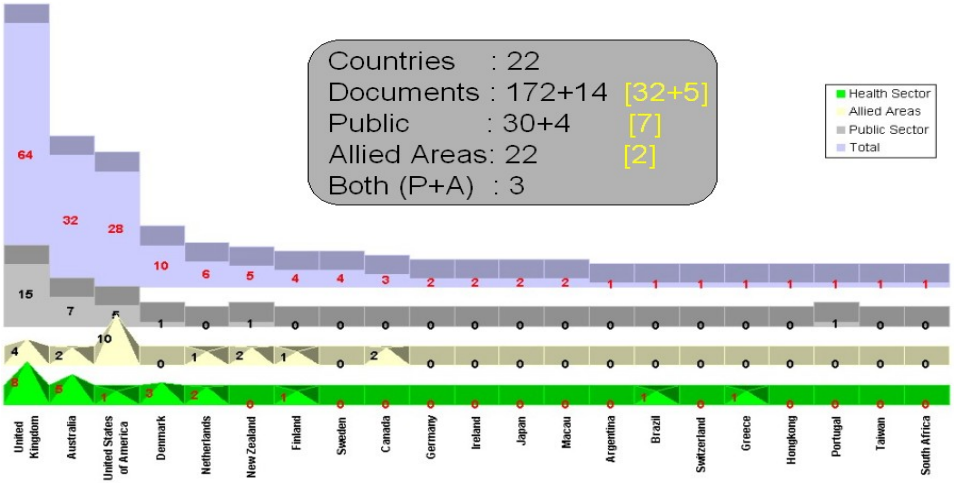

Figure 3. Distribution – Country wise.

D. Distribution – Involving more than one country

Fig. 4 below shows distribution of SSM documents involving more than one country.

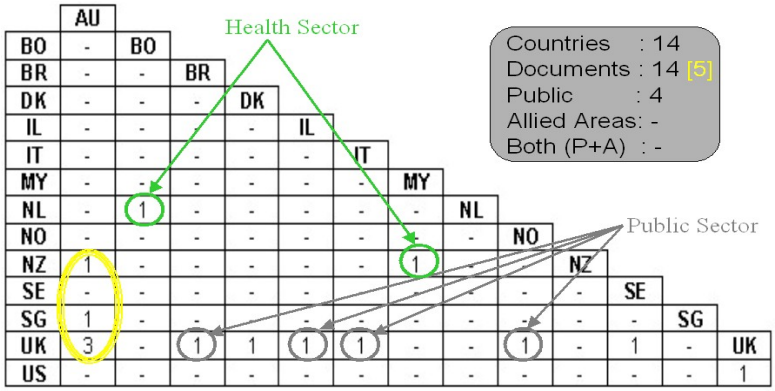

Figure 4. Distribution – Involving more than one country.

E. Distribution – Category wise

Fig. 5 below shows category wise distribution of SSM documents.

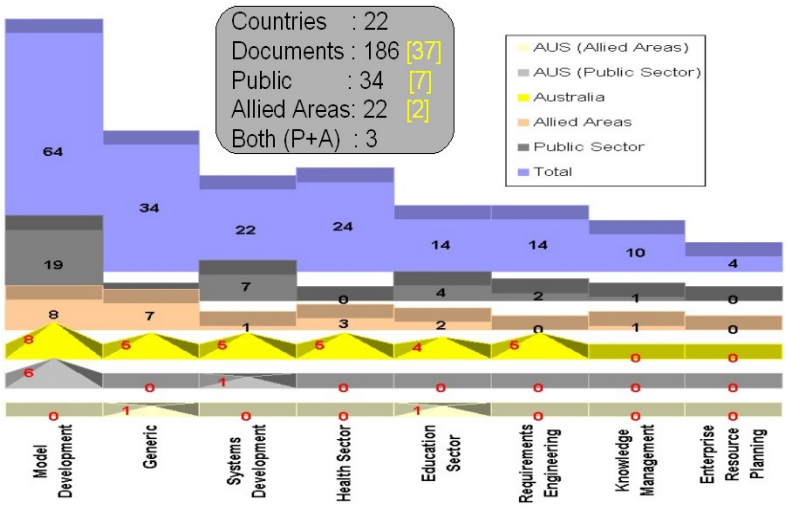

Figure 5. Distribution – Category wise.

F. Distribution – Public sector and domains addressed in Public sector

Fig. 6 below shows distribution of SSM documents in the Public sector and various domains addressed in Public sector.

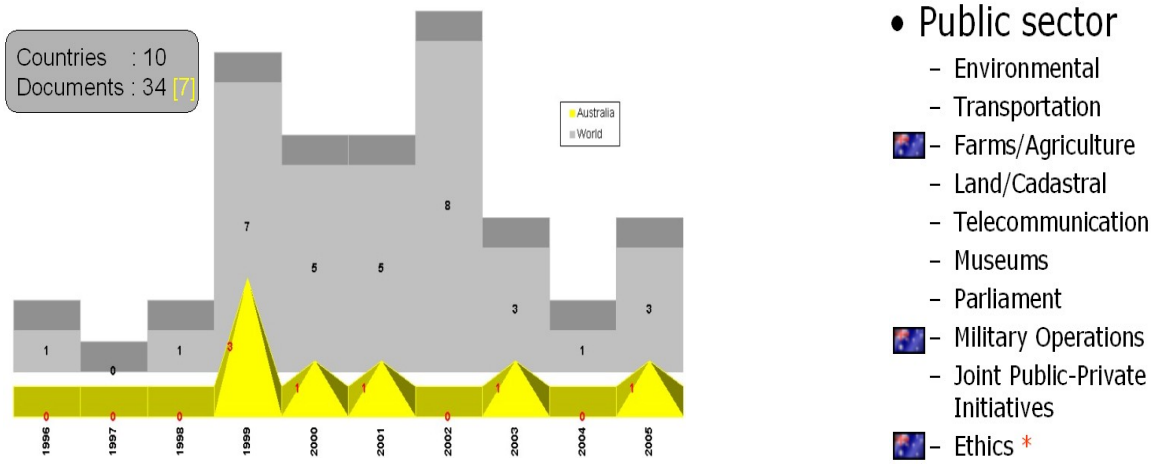

Figure 6. Distribution – Public sector and domains addressed in Public sector.

G. Distribution – Health sector and domains addressed in Health sector

Fig. 7 below shows distribution of SSM documents in the Health sector and various domains addressed in Health sector.

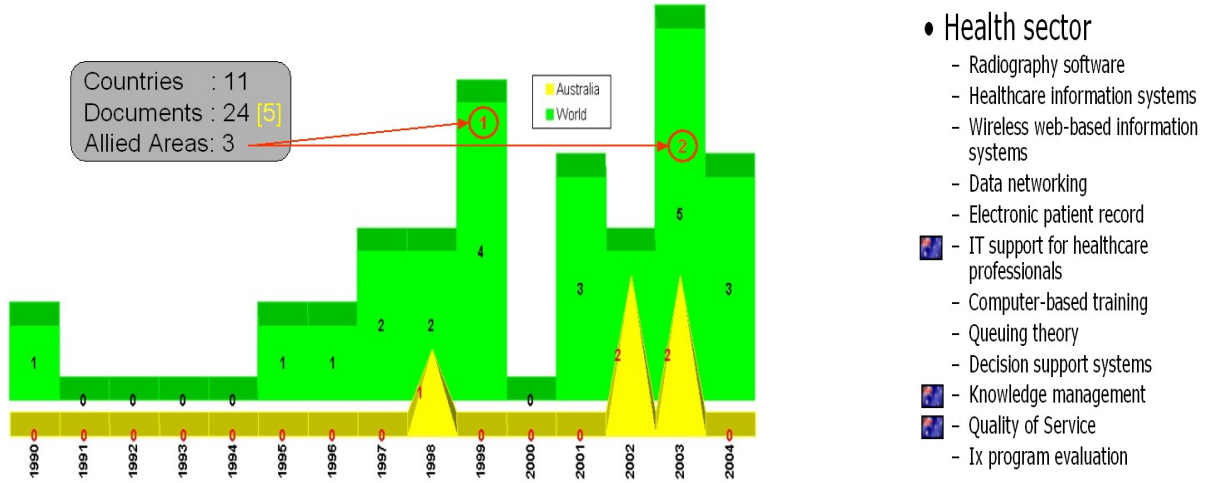

Figure 7. Distribution – Health sector and domains addressed in Health sector.

H. Distribution – Australia

Fig. 8 below shows distribution of SSM documents in Australia.

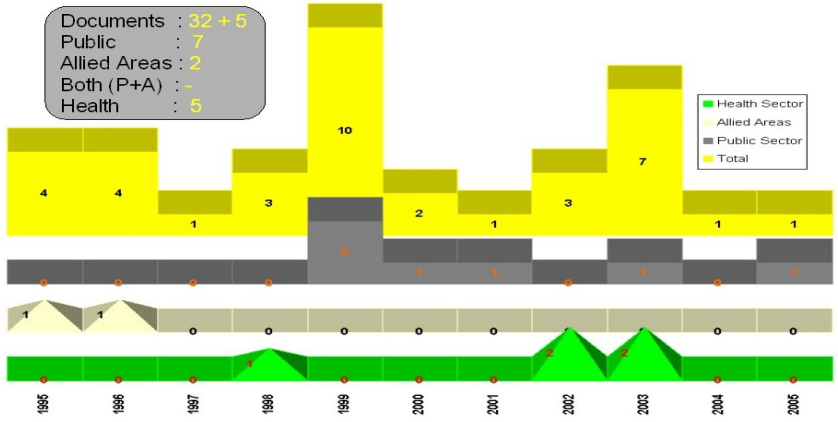

Figure 8. Distribution – Australia

CONCLUSION

In Health, as indeed all business sectors, dynamic developments in technology continue to drive challenging opportunities for paradigm shifts in service delivery. Change Managers need to seek the best approaches, methodologies and frameworks for success and it is in this context that SSM has considerable potential.

Acceptance of SSM is evolving since introduction. It has been applied in some sections of Health Sector. SSM is not a new concept in Australia (including in Public Sector) and it deserves more place to contribute in Health Business Environments.

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The author would like to thank the members of the Centre for Health Informatics Research of Curtin University of Technology, Perth (Australia) for the support provided during the author's short-term period of stay there as 'Adjunct Research Fellow'.

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Rural Telemedicine: Lessons from Alaska for Developing Regions

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"Telehealth is about people and processes, not just about the technology"1

Abstract: **Alaska shares many characteristics with many other rural and remote regions of the developing world, including a small population spread over a large area, lack of roads linking villages to hospitals, a significant indigenous population, and a shortage of doctors in rural areas. Satellites brought reliable voice communication with village health aides in the 1970s. Alaska has now introduced the first permanent upgrade to the voice satellite system, known as the Alaska Federal Health Care Access Network (AFHCAN). This satellite-based system is now the world's most extensive telemedicine network, linking 248 sites, including 158 village health centers. This paper examines the approach used to design the network, and includes preliminary findings on utilization of the network and associated cost-savings. It also discusses the U.S. Universal Service Fund subsidy for rural health care facilities. It concludes with lessons learned that could be applicable for other remote and isolated areas and developing regions.**

I. TELEMEDICINE AND TELEHEALTH

In the programs described here, applications of telecommunications in support of health care are referred to as "telemedicine," although some researchers and practitioners prefer to use that term for consultative uses, and the term "telehealth" to refer to applications for continuing medical education and administration. Information and communication technologies (ICTs) can be used to support health services including the following:

- Emergencies: to summon immediate medical assistance; to communicate with emergency vehicles and staff;
- Consultation: typically between primary health care providers and district level physicians, or between district physicians and specialists;
- Remote diagnosis: e.g. transmission of medical data and images, interpretation of data by distant specialists;
- Patient monitoring: e.g. transmission of patient data from home or rural clinic, often coupled with follow-up through local medical staff;
- Training and continuing education: of health care workers, paraprofessionals, physicians, etc.;
- Public health education: of target populations including expectant mothers, mothers of young children, groups susceptible to contagious diseases, etc.;
- Administration: ordering and delivery of medications and supplies; coordination of logistics such as field visits of medical staff; accessing and updating of patient medical records; transmission of billing data, etc.;
- Data collection: collection of public health information such as epidemiological data on outbreaks of diseases; and
- Research and information sharing: such as access to medical data bases and libraries and consultation with distant experts and peers.

II. THE CONTEXT

A. The Rural Context

The health sector in developing countries confronts major administrative, quality control, and logistical problems. In general, health care in developing countries must be dispensed by individuals with less training and less backup than their counterparts in industrialized countries. Developing regions typically face severe shortages of physicians, particularly in rural areas. Specialists may be available only in the major cities. Health workers may have only minimal training, or have few opportunities to upgrade their knowledge and skills. Facilities for treating patients may be inadequate in terms of staffing, equipment, and medications.

1 Morgan, Peter, Sarah Muttitt, David Allen, Carol Anderson, Linda Weaver. "Inventory and Assessment Report for the Alaska Federal Health Care Access Network Project." TecKnowledge, Toronto, Canada, 2001. (available at www.afhcan.org)

In addition, mortality and morbidity rates are generally higher than in urban areas due to poor sanitation and other environmental conditions, and dangerous occupations.

B. The Alaskan Context

Geographically, Alaska is the largest state in the United States, covering an immense area of 586,412 square miles, with a total population of 621,400. About half the population lives in Anchorage; only four communities in the state have a population greater than10,000. About 16 percent of Alaskans are native American, including Tlingit and Haida Indian tribes in the southeast, Athabaskan Indians in the interior, Inupiat and Yupik (Eskimos) near the Arctic Ocean and Bering Sea, and Aleuts in the Aleutian Islands. Some 25 percent of Alaskans, and 46 percent of Alaska native people, live in communities of less than 1,000 people. The concept of "rural" has a different connotation in Alaska than in many other regions; some 75 percent of Alaskan communities have no road connection to a hospital.2 Transportation is by boat along the coast or rivers in the summer, and by bush plane year round, weather permitting.

Alaska ranks 48th out of the 50 states in the ratio of doctors to residents, and the vast majority of physicians are located in Anchorage. There are also shortages in many medical specialties. At the village level, health care is delivered by community health aides. They are local residents (primarily women) who receive basic medical training and provide first line care for the villagers. Younger aides typically have high school education; older aides may have less formal education, but all read and speak English. Health aides are supervised by medical staff in regional hospitals that are now operated by native health corporations with funding from the U.S. Public Health Service, which is responsible for providing health care for native Americans. More than 575 health aides in 200 villages provide nearly one half million patient encounters per year.3

Communication services to remote villages are provided primarily by satellite because of the vast distances and conditions such as mountains, permafrost and lack of roads that make terrestrial networks impractical. Local telephone service is provided by 25 local exchange carriers (LECs), ranging from major companies with multiple franchises to community cooperatives and small "mom and pop" phone companies. The two major intrastate long distance companies include the current owner of the original long distance network acquired from the military in 1971 and then expanded, and an Alaska-based company founded in 1979 that provides voice, video and data communication services to more than 150,000 residential, commercial and government customers.

III. EARLY TELEMEDICINE IN ALASKA

The community health aide (CHA) system was established in 1954, after a U.S. government report stated that "the indigenous peoples of Native Alaska are the victims of sickness, crippling conditions, and premature death in a degree exceeded in few parts of the world."[4] The program began with training of sanitation aides who returned to their villages to instruct others in maintaining safe drinking water and proper trash disposal. In 1956, the program was expanded to train community aides as firstline health workers. A rural doctor pointed out: "It is not a question of whether the villagers shall be treated by completely qualified medical personnel or persons with less than full qualifications, but a question of whether they shall be tested by persons with limited qualifications or go untreated altogether."[5]

A health aide described those early days: "We had no clinic. We went from house to house taking care of the sick... Our tools consisted of a thermometer, a stethoscope, and a blood pressure cuff...We had no phones, no radios, but used the school's radio to report our patients. There was no nonsense about confidentiality."[6] However, in 1972, villages in central Alaska began to communicate with a regional hospital and the Anchorage Native Medical Center (ANMC) using a single channel on the National Aeronautic and Space Administration's (NASA's) ATS-1 satellite. The experiment showed that reliable communications could indeed save time and even lives, and that health aides also learned from each other's experiences heard in consultations over the shared audio channel. [7] As a result, the State authorized an expenditure of $5 million for the purchase of satellite earth stations for 200 villages that communicated through RCA's first commercial satellite. Each village had a public payphone and a dedicated audio channel for health communications, linking the villages with their regional hospital and with ANMC.

IV. ALASKAN TELEMEDICINE TODAY: THE AFHCAN PROJECT

Today, rural native health care is delivered through native health corporations, which in turn receive funding from the Public Health Service, the federal agency responsible for providing health services to native Americans. Community health aides are still the frontline providers of village health care, but a new federally funded project called AFHCAN (Alaska Federal Health Care Access Network) is extending their capabilities through telemedicine, using upgraded satellite facilities that now also provide telephone service for clinics and village residents. AFHCAN provides telemedicine facilities for all federally funded health services in the state, some 235 sites including military installations, Alaska Native health facilities, regional hospitals, small village clinics, and state of Alaska public health nursing stations, affecting more than 212,000 beneficiaries, the

2 Ferguson, Stewart and Chris Patricoski, "Telemedicine in Alaska: The AFHCAN Project". Presentation to IEEE International Conference on Communications participants, Anchorage, May 2003.

3 Ferguson, Stewart and Chris Patricoski, "Telemedicine in Alaska: The AFHCAN Project". Presentation to IEEE International Conference on Communications participants, Anchorage, May 2003.

4. Quoted in Nice, Philip and Walter Johnson. *The Alaska Health Aide Program: A Tradition of Helping Ourselves.* Anchorage: University of Alaska Anchorage, Center for Circumpolar Health Studies, 1999.

5. Quoted in Nice and Johnson, *ibid.*

6. Quoted in Nice and Johnson, *ibid.*

7. See Hudson, Heather E. and Edwin B. Parker. "Medical Communication in Alaska by Satellite." *New England Journal of Medicine*, December 20, 1973.

majority of whom are in rural Alaska Native villages.[8] Some 38 partner organizations are involved.

Project planners took several steps to design the project to be sustainable. For example, they took particular care to understand the needs of the users (aides and physicians who will use the system) and customers (those who will pay for its ongoing operation). They noted that 67 percent of the sites have community health aides, and thus made sure that equipment and training were designed for these aides and facilities in village clinics.

Further, they designed the system to address priority medical problems. The Clinical Committee established for the project stated it should focus on primary care (i.e. treating people in village clinics and similar installations), rather than secondary care (at regional hospitals) or tertiary care (e.g. at the Anchorage medical center). An example of equipment included to address the priority problem of otitis media (middle ear infection, which can cause deafness in children) is an electronic otoscope. They also designed the telemedicine system to be scalable, to adapt to expanded requirements, new applications, and more users.

Facilities for clinics could include centralized and dedicated computer equipment such as servers, a specially designed telemedicine cart and peripherals including a digital camera, electronic otoscope and electrocardiogram (ECG), printers, scanners, routers, wireless networks and customized furniture.9 The project technical staff chose suitable off-the-shelf equipment wherever possible (such as a rugged and simple-to-use digital camera). Where standard equipment was not suitable, they worked with vendors to make modifications (such as on the equipment cart, which was designed to move easily within the clinic.) In some cases, wireless networking was used to avoid attaching long cables to movable carts. Deployment options for the partner organizations included installation by the centralized project, shared installation, or independent installation , i.e. the organization procured the equipment from the project but was responsible for its own installation.

After reviewing products from numerous vendors, the project team decided to develop its own software, designing it to run on a wide variety of platforms (Unix, Windows, Macintosh, Linux) and range of connectivity, from dial-up to T1 circuits. This custom software meets federal security standards for patient data using secure socket layer (SSL), and is designed to minimize capacity for data transmission (e.g. through eliminating retransmission of data already transmitted).10

Thus, instead of relying only on verbal descriptions from health aides or sending x-rays to Anchorage, doctors at regional hospitals can now use the AFHCAN network. As noted above, each village clinic is equipped with a personal computer with peripherals including a digital camera, electronic otoscope (for ear infections) and ECG. One common application is for diagnosis of otitis media, a common ear infection among village children that can cause deafness if not treated in time with antibiotics. Health aides can use an electronic otoscope connected to the computer to transmit images of the ear canal. They can also take pictures of wounds, sprains, dermatological lesions, etc. using the digital camera, and transmit the photo as an attachment to an email message to the doctor. The equipment can also be used to send digitized x-rays. "In the past," stated the information manager of the Maniilaq health center, "there was a big delay in the process. There would be times when the bone would set before a diagnosis could be made. Now we digitize the film, and it's in Anchorage the same day."11

The availability of computers in village clinics also makes it possible to use electronic training and reference materials. The Community Health Aide Manual is now available on a CD ROM. Training materials for operating the telemedicine equipment are online12, and the network can also be used for continuing education of the health aides.

V. UNIVERSAL SERVICE FUND FOR RURAL HEALTH SERVICES

Although the AFHCAN equipment is designed for locations with only a dial-up phone line (or equivalent), most sites now have subsidized broadband connectivity. The Telecommunications Act of 1996 expanded the original purpose of the Universal Service Fund (USF) to extend reasonably priced telephone services to rural and other underserved areas to include support for the cost telecommunications services for schools, libraries, and rural health care providers. In section 254 of the Act, Congress sought to provide rural health care providers "an affordable rate for the services necessary for telemedicine and the instruction relating to such services." Specifically, Congress directed telecommunications carriers "to provide telecommunications services which are necessary to health care provision in a State, including instruction relating to such services, to any public or nonprofit health care provider that serves persons who reside in rural areas of that State, at rates that are reasonably comparable to rates charged for similar services in urban areas of that State."13

The Federal Communications Commission (FCC) sets the overall policy for the program, which is administered by a nonprofit entity, the Universal Services Administrative Company (USAC). The Rural Health Care Division of USAC administers a program that provides up to $400 million annually so that rural health care providers pay no more than their urban counterparts pay for the same or similar telecommunication services.

Funds come from telecommunications carriers, which are required to contribute a set portion of their revenues to the USF. Carriers generally pass through these costs to customers through itemized charges on their telephone bills. The FCC makes payments from this central fund to support the Schools and Libraries Program and the Rural Health Care Program, as well as other Universal Service programs that provide subsidies for low-income subscribers and high-cost service areas.

8. See www.afhcan.org.
9 Sivitz, H., Hanna, B. and Wregglesworth, B. "AFHCAN Deployment: Completing the Installation of 235 Sites in Alaska." *Telemedicine Journal and E-Health* 9 (Supplement 1): S 64.
10 See www.afhcan.org/technology/software/cpm
11 Personal interview, Kotzebue, May 2000.
12 See www.afhcan.org/training.
13 Public Law 104-104, the Telecommunications Act of 1996. See 47 U.S.C. (h)(2)(A)

To qualify for universal service support, a health care provider (HCP) must be a public or not-for-profit organization located in a rural area. In addition, not-for-profit HCPs, in both rural and urban areas, may qualify for Internet access assistance if they are unable to access the Internet via a toll-free or local call, and must therefore dial into the Internet via a toll (long distance) call. The HCP may seek support for eligible services, which include mileage-related charges, various types of connectivity from leased telephone lines to frame relay, integrated services digital network (ISDN) or T1 circuits, mileage charges, and one-time installation charges. End user equipment such as computers, telephones, fax machines, as well as maintenance charges, are not eligible for support. 14 All telecommunications common carriers may participate, including interexchange carriers (IXCs), wireless carriers, and competitive local exchange carriers.

Each eligible HCP requests bids for telecommunications services to be used for provision of health care through postings on the USAC website. Requests for bids must be posted on the USAC website for 28 days before the HCP can enter into an agreement to purchase services from a carrier. The HCP must consider all bids received and select most cost-effective method to meets its health care communication needs. 15 Although Alaska has been a major participant in the health USF program, by 2003, only 1194 of 8300 potential applicants had received support, and the fund disbursed only $30.25 million in first five years out of a potentially available $200 million. Therefore, the FCC has recently implemented several changes to eligibility requirements and comparative pricing guidelines designed to make the USF discount more widely available and simpler to implement.16

VI. LESSONS LEARNED FROM AFHCAN

The AFHCAN network is still in its early days, and results of analysis of patient encounters are preliminary. However, there are already several findings from this project that are relevant for other rural and isolated regions, including the mountainous areas and scattered islands of the Asia-Pacific.

A. Saving Time

Telemedicine links between a community health aide and doctor at a regional hospital can enable patients to be seen quickly who would otherwise have to wait for a visiting doctor or for arrangements to be sent to a regional clinic. The following feedback from a regional physician is illustrative: "We have done about 150 telemedicine cases at this point, patients who would have normally been placed on a waiting list to be referred to the regional ENT clinic. Waiting times range from 2-6 months. … We review the cases and make recommendations within 24 hours.17 Turnaround times for teleradiology have also greatly decreased for diagnostic interpretations from 9 to 21 days to within 24 hours, and immediate response for emergencies.

B. Improving Quality

Catching patients early may prevent deterioration of patients' conditions; such consultations may also be valuable for preventive care. Analysis of cases will be required to determine impact on treatment and outcomes. Concerning telegradiology, village clinic imaging is performed by midlevel staff, health aides, and sometimes clerical staff. Training that is focused on taking X-rays has improved the quality of images seen by the radiologist.18

C. Saving Money

The AFHCAN system can save money as well as time. Preliminary analysis of cases showed that 29 percent of consults prevented travel by the patient to a hospital.19

Earlier analysis of a pilot network similar to AFHCAN found that an evacuation by plane can cost from $10,000 to $25,000. The package of computer, peripheral equipment, and training is estimated to cost $22,000, so that if it saved two evacuations, it would pay for itself.[20]

Even when medical evacuations are not required, scheduled transport to a regional hospital can be very expensive. Rural residents travel an average of 147 miles one way for access to next level of care. The cost of roundtrip airfare to a regional center may be $600 or more. Roundtrip airfares to Anchorage from a village may exceed $1800. AFHCAN evaluation data indicate that 37% of the time, telemedicine usage prevents the patient and family from having to travel. Extrapolated to 13,307 through 2003, encounters, the result is over $2.8 million saved in airfares alone.21 An additional social benefit is that patients who can be treated locally do not have to leave their home communities.

However, it should also be noted that a telemedicine consultation may cause patient travel because a serious problem is identified that would have been missed by the health aide. Approximately 8 percent of the analyzed patient consults resulted in patient travel. (These findings are remarkably similar to data from the ATS-1 satellite telemedicine experiment evaluated by the author and colleagues 30 years ago!)22

D. Involving the Users

14 For details, see www.rhc.universalservice.org/eligibility/services.asp.
15 The Federal Communications Commission (FCC) defines "most cost effective method" as "the method of least cost after consideration of the features, quality of transmission, reliability, and other factors relevant to choosing a method of providing the required services." See www.rhc.universalservice.org.
16 Federal Communications Commission, Report and Order, Order on Reconsideration, and Notice of Proposed Rulemaking in the Matter of Rural Health Care Support Mechanism, November 13, 2003.
17 Quoted in Stewart Ferguson and Chris Patricoski, "Telemedicine in Alaska: The AFHCAN Project". Presentation to IEEE International Conference on Communications participants, Anchorage, May 2003.
18 Sivitz, H., Midthun, J., and Deis, R. "An Overview of Teleradiology in Alaska." *Telemedicine Journal and E-Health*, 9 (Suppl 1): S60.
19 Stewart Ferguson and Chris Patricoski, "Telemedicine in Alaska: The AFHCAN Project". Presentation to IEEE International Conference on Communications participants, Anchorage, May 2003.
20. Personal interview with project director Fred Pearce, Anchorage, August 1999.
21 See www.afhcan.org/about/costsqualityaccess.aspx.
22 See Hudson, Heather E. and Edwin B. Parker. "Medical Communication in Alaska by Satellite." *New England Journal of Medicine*, December 20, 1973.

An assessment of the AFHCAN project in 2001 noted that "telehealth is about people and processes, not just about the technology."23 Accordingly, it recommended an increased emphasis on staff and organizational issues including the following:

- Shift focus from deployment to increasing usage and operational success;
- Increase cooperation and sharing [of expertise] among participating organizations;
- Identify clinical needs to use equipment;
- Develop comprehensive training plan for various users (from physicians to health aides) etc.

In general, these recommendations have now implemented. Also, a help desk and technical support system have been established.24

E. Designing for Sustainability

The AFHCAN planners selected or adapted equipment that is rugged to withstand field conditions such as power and temperature fluctuations and cramped space, and easy to use (taking into consideration the likelihood of high staff turnover and need for retraining). They attempted to minimize capital and operating costs by choosing low cost (but highly reliable) equipment and transmitting data (digital pictures, ECG, patient information, etc.) primarily in store-and-forward mode.

All of these strategies contrast with the approaches of many telemedicine projects which use expensive equipment to transfer video or other images across broadband networks, primarily for consultation with tertiary level specialists.

F. Using Incentives for Universal Service

An important element of the USF program is that it is designed to be incentive-based. Subsidies are not awarded directly to the carrier but to the user, i.e. it is the health care provider which is eligible to receive the discount. Like a voucher system, the fund can empower rural health care providers, because they now have resources for technology, rather than being relegated to the sidelines by the telecommunications companies as unlikely or undesirable customers. Thus, an Alaskan telecommunications official noted that the USF created a competitive environment in Alaska that is vendor neutral, puts the power of choice in the hands of the consumer, and offers a subsidy program that attracts long term capital investment.25

In contrast, other countries generally subsidize the carrier directly to install facilities or to provide services at a reduced price. This approach creates no incentives for new entrants nor for keeping construction and operating costs down. Quality of service may also suffer if the facilities and services are perceived to be of low value, and/or the carrier concludes there is little likelihood of ongoing service without the subsidy.

G. Stimulating Innovation in Telecommunications Services for Telemedicine

The AFHCAN project and funding available for rural telemedicine under the USF have stimulated innovation by a major telecommunications carrier serving Alaska. GCI, a regional integrated services provider headquartered in Anchorage, has contracts to provide satellite connectivity for telemedicine in several isolated regions of Alaska. Experience providing these services led GCI to design a secure network called ConnectMD designed to provide Alaska's medical practitioners with secure, reliable connectivity for transmission of patient information using secure Health Insurance Portability and Accountability Act 26 (HIPAA)-enabled connections. 27 GCI plans to offer this service to telemedicine providers in other regions.

VII. CONCLUSION

Current telemedicine initiatives in Alaska have major relevance for use of telecommunications to support health care delivery in other isolated and developing regions. The strategies to plan the project emphasizing primary care and priority needs, and to take into consideration training levels of health aides and village conditions, are critical for developing regions.

Preliminary data indicate that the project is effective in reducing travel costs and enabling patients to be treated with the advice of a doctor who would otherwise not have been seen by a doctor or would have had long waiting periods. Evaluating true cost effectiveness remains difficult, as AFHCAN was funded by a Congressional appropriation, and costs of broadband connectivity are subsidized by the Universal Service Fund. However, project planners made every effort to use equipment suitable for village settings, and to design applications that could run on narrowband (such as dial-up) circuits. The emphasis on store-and-forward applications and use of simple digital cameras to take photos that can be sent as attachments to email messages are examples of cost-saving techniques appropriate for developing regions.

Finally, the incentive-based model for provision of universal service also appears appropriate for isolated and developing regions. Rather than requiring providers to serve remote areas at a loss, the USF mechanism offers a least-cost subsidy for providers that can demonstrate capability to provide designated services. The availability of a subsidy for Internet connectivity to schools and rural health centers can result in these locations becoming "anchor tenants" for a carrier in a community, creating an incentive to then extend service to other locations.

23 Morgan, Peter, Sarah Muttitt, David Allen, Carol Anderson, Linda Weaver. "Inventory and Assessment Report for the Alaska Federal Health Care Access Network Project." TecKnowledge, Toronto, Canada, 2001. (available at www.afhcan.org)

24 Abdallah, A. and Hanna, B. "Technical Support for Telemedicine, an Alaska Experience." Telemedicine Journal and E-Health 9 (Suppl 1): S72.

25 Cary, Martin. "Universal Services in Alaska: The Impact of the E-Rate on Rural Alaska." Presentation to IEEE International Conference on Communications, Anchorage, May 2003.

26 Health Insurance Portability And Accountability Act of 1996, Public Law 104-191, 104th Congress, Aug. 21, 1996.

27 See www.connectmd.com. See also "Telehealth in the Tundra," *Health Management Technology,* March 2004. See www.healthmgttech.com.

Purchasing computer program (application) for health

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At a time when health institutions and health workers are purchasing not only hardware, but are also actively purchasing the accompanying software, they should have some specific knowledge how to avoid unforeseen costs or unexpected difficulties (delays, narrowing of programme use possibilities etc.).

The paper offers rules and recommendations to follow in software purchases. It focuses on the content of tender documentation, method of purchase, offer assessment criteria, buyer's involvement in programme development, software ownership, specification of requirements, trial run and its assessment, selection of application builders (not of their providers), multifunctionality of the programme, selection of technology, and the norms and standards recommended for applications.

Tackled separately is the content of purchase contract. The contract should be brief, clear and invoking contract annexes that present in minute detail and accurately the respective rights and obligations of the purchaser and provider. These annexes are technical description of the solution and scope of work, specification of software deliveries and servicing, delivery organisation and schedule, division of responsibility, price specification, method of payment, takeover procedure for the work completed, maintenance and support, time limits and conditions applying to the use of intellectual property rights, etc).

Keywords: computer program, purchase, tender documentation, health, contract

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[3] Stevanovic, R. Stanic, A. et all. Development of Informatic's System and Telemedicine in Croatian Primary Healthcare // Med e-tel, The International trade event and Conference for Health, Telemedicine and Health ICT / Collignon, Jean-Michel (ed.).Luxembourg : Med e-Tel, (58-59) 2005.

Progress of e-Health in Australia: OACIS (The Open Architecture Clinical Information System)

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Abstract- Providing healthcare services to its citizens is government's responsibility and only a seamless integration of facilities between healthcare service providers can deliver this better. Clinical Information System (CIS) is a key component of any e-Health model. This paper portrays the Oacis Programme as a state of the art implementation by the South Australian Department of Human Services (DHS). It also touches topics related to Health*Connect*, the Health Information Network for all Australians. *v*OACIS™, the EHR solution from DINMAR (Canada) has also been explained. Contents of this paper were presented at the public seminar "Reviewing the South Australian OACIS Model (Open Architecture Clinical Information System)", for the Centre for Health Informatics Research and St John of God Health Care, at St John of God Health Care, Subiaco (WA).

Keywords- EHR, e-Health, Open Architecture, CIS, OACIS, HealthConnect. Note: Permission has been obtained by DINMAR for displaying its logo.

INTRODUCTION

Healthcare is an institution that meets some of society's most critical needs and any member of society sometime or other may avail these services. Providing healthcare services to its citizens is government's responsibility and only a seamless integration of facilities between healthcare service providers can deliver this better. ICT (Information and Communication Technology) provides the necessary infrastructure and software tools to make this connectivity effective, thereby moving the concept of 'Health' to 'e-Health'. Clinical Information Systems (CIS) is a key component of any e-Health model.

This paper portrays Oacis Programme as a state of the art implementation by the South Australia's Department of Human Services (DHS). It also touches topics related to Health*Connect*, the Health Information Network for all Australians. *v*OACIS™, the EHR solution from DINMAR (Canada) has also been explained.

CIS (CLINICAL INFORMATION SYSTEM)

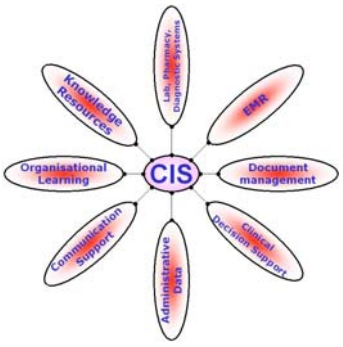

Figure 1. Components of a CIS.

Ref. [1] Clinical information system is an umbrella term that has been applied to a broad range of clinical information technology and to various configurations of clinical application components. Additional terms are used to describe information systems that support delivery of health care: electronic medical record systems, health information system, and computer-based patient record systems are a few.

Fig. 1 above shows various components that are often featured in a CIS:

- **Laboratory** Management System, **Pharmacy** Management System and **Diagnostic Image** Management System are to help clinicians in completing their clinical tasks.
- The **EMR** (Electronic Medical Record) gives and integrated view of patient's data to the health care service provider.
- **Document management** allows the health care service provider to record their diagnostic, case management, and treatment actions.
- **Clinical decision support** can be created based on data from the EMR and evidence-based practice guidelines.
- Access to **administrative data** such as ADT (admission/discharge/transfer) record, bed allocation, surgery schedule, etc. for tracking patient movement.
- **Communication** among various concerned health care service providers to improve continuity of patient care during transition between multiple clinicians.
- Access to **knowledge resources** e.g. reference materials, journal articles, etc.

HISTORY OF THE OACIS PROGRAMME IN SOUTH AUSTRALIA

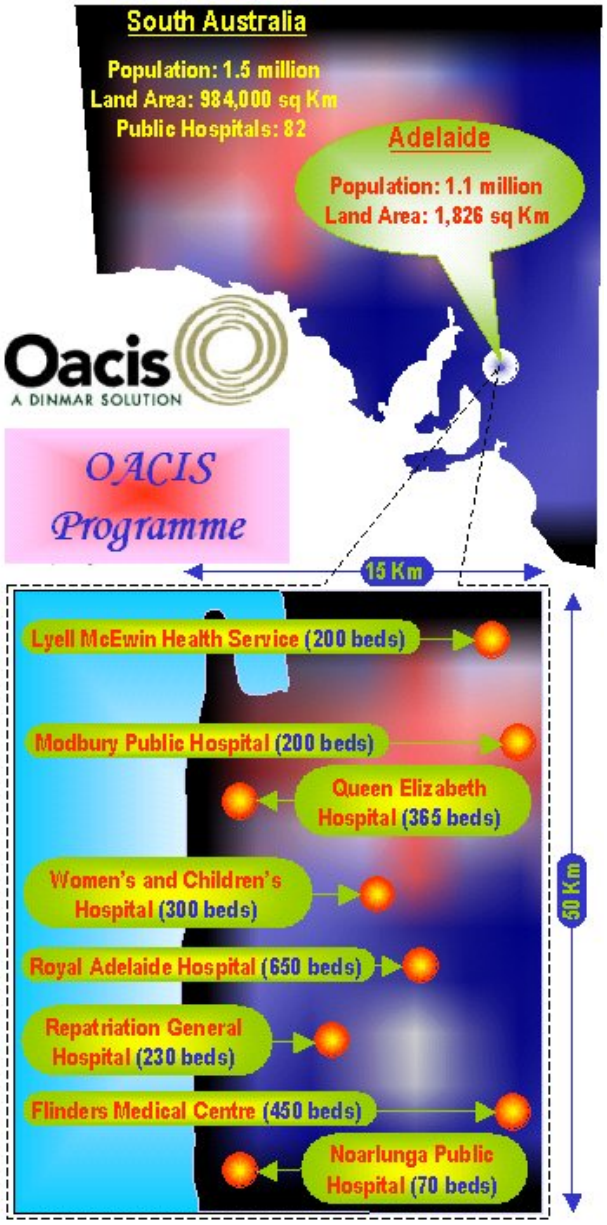

Figure 2. History of the Oacis Programme.

Ref. [2, 3, 4] Fig. 2 above shows the Oacis Programme implementation locations at Adelaide in the state of South Australia. There are 82 public hospitals across South Australia with 8 major public metropolitan hospitals servicing 75% of the State's pollution of 1.5 million.

1990: The DHS (decommissioned on 30 June 2004) felt the need to improve Clinical Information System, to enable clinical best practices and thereby improve quality of care.

1995: The Renal Information System at the Queen Elizabeth Hospital required replacement. After conducting a worldwide survey looking at both clinical and technical requirements, DHS selected OACIS out of west coast of the USA, now owned by DINMAR in Canada. OACIS is an open architecture based, enterprise wide clinical information system providing real time access to clinical data.

1997: Pilot implementation of the Oacis Programme was carried out by the ICT Services Projects Branch of the Department of Health of South Australia in partnership with Accenture (a global management consulting, technology services and outsourcing company) in the Renal Units of 4 of the metropolitan hospitals (Queen Elizabeth Hospital, Royal Adelaide Hospital, Flinders Medical Centre and Woman's and Children's Hospital) to test and evaluate benefits and outcomes able to be achieved.

1999: OACIS Enterprise Wide Steering Committee was established.

2001: The General Practice Computing Group (GPCG) successfully converted data from OACIS to GEHR (Good Electronic Health Record) and vice versa. The Oacis programme implementation was extended across all 8 major metropolitan public hospitals.

2004: The Department of Health of South Australia participated in the implementation of first stage of Health*Connect*.

*v*OACIS™: THE EHR SOULTION FROM DINMAR

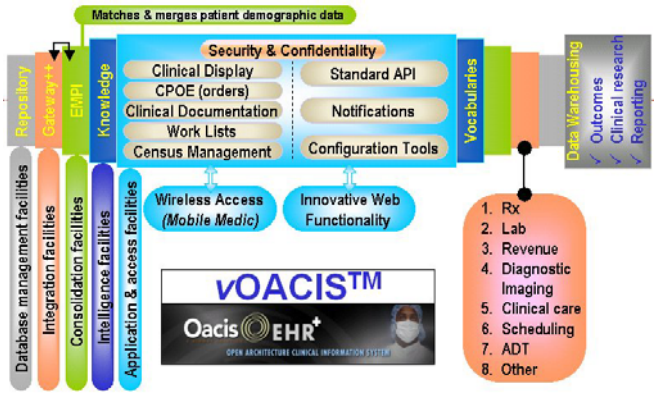

Figure 3. *v*OACIS™: the HER solution from DINMAR.

Ref. [5, 6] Fig. 3 above describes *v*OACIS™, an EHR solution form DINMAR, Canada:

Database management facilities: A centralised **clinical data repository** build with highly scalable and extendable database containing lifetime (complete) patient data which are fully integrated with clinical applications. The accumulated patient data repository also permits **data warehousing**. *The Sybase data repository runs under Sun Solaris or HP UX operating system.*

Integration facilities: Consists of **Gateway++**, an open architecture based interoperability engine using HL7 (Health Level 7) interface. Gateway++ can handle different protocol format and can connect all **systems (Rx, Lab, ADT, etc.)** by accepting, parsing, translating, reformatting, and forwarding data. *Gateway++ runs on high-performance RISC computers from Sun Microsystems.*

Consolidation facilities: Consists of the **Enterprise Master Patient Index (EMPI)** application that previews all transactions streaming through the network. EMPI links disparate records together using a sophisticated matching algorithm, regardless of patient identification schemes used in feeder system matches. Duplicate patient records are

identified and linked through a global identifier and eliminated across the entire enterprise. Finally, the records earmarked for "merge" are merged to provide the clinicians with a complete and comprehensive patient record. *The key patient identifiers are stored in EMPI database (Sybase) and uses TCP/IP protocols*.

Intelligent facilities: Provides a common environment into which third party **knowledge object** can be plugged. *e.g. pharmacy vocabularies, clinical vocabularies, rules engines, rules objects, coding structures, etc.*

Application & access facilities: *vOACIS™ applications, developed using standard Java™ technology and standard HL7 interfaces, enable clinicians to practice care within the EHR anywhere, any time via an Internet browser and/or mobile device. Secured web-transaction is guaranteed through SSL (Secured Socket Layer) and PKI (Public-Key Infrastructure) using 128-bit encryption. While, Confidentiality is maintained using role and group-based access to all applications*.

- **Clinical Display:** presents patient data summary at the point of care in a "dashboard-style" interface with drill down detail. The interface can be personalised by each user using site configuration tools.
- **Computerised Physician Order Entry (CPOE):** enables quicker diagnosis and treatment decisions and helps the clinicians in placing even complex orders within seconds. The CPOE is fully interoperable with existing ancillary systems including pharmacy.
- **Clinical Documentation:** a flexible, easy to use electronic documentation integrated with electronic ordering, care plans, and results.
- **Work Lists:** the CPOE and Clinical Documentation automatically produce configurable work lists, which helps in streamlining the succession of clinical actions required to deliver safe and effective clinical services.
- **Census Management:** allows clinician to perform ADT and bed management functions when the ADT system is unavailable so effective care delivery never stops. Fig. 4 below shows how a local admit is performed the moment when a patient approaches a local workstation [7].

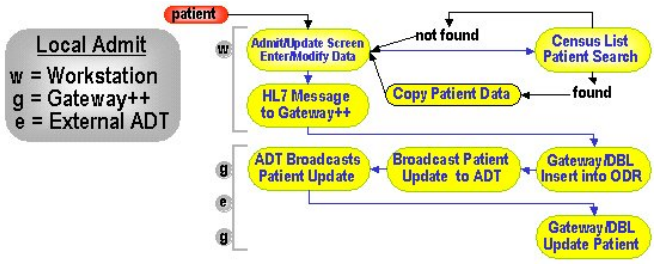

Figure 4. Census Management.

IMPLEMENTATION OF THE OACIS PROGRAMME

The drivers of Oacis Programme are:

- Improved patient safety and higher standard of patient care by timely providing patient information for better clinical decision making; and
- Increased patient satisfaction and improved efficiency of health care delivery by reduced duplication of patient information collection and their pathology and radiology tests.

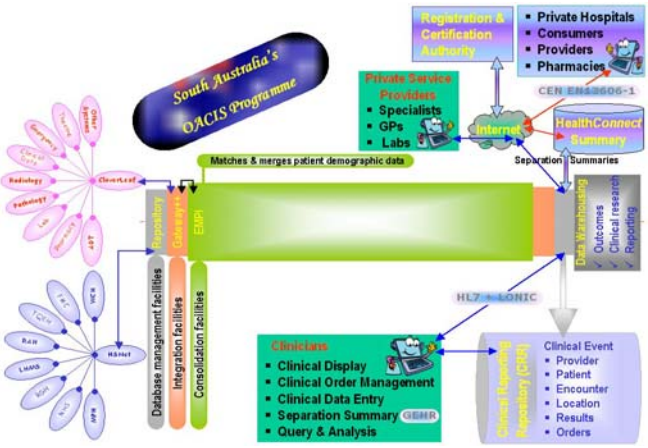

Figure 5. The Oacis Programme.

Ref. [8, 9, 10] Fig. 5 above describes the Oacis Programme along with its input to Health*Connect*:

Oacis Data Repository (ODR): consists of *Sybase database (replicated) running under two Sun Microsystems E6500 servers* (20 CPUs at 400 MHz each, 15 GB Memory, 700 GB Disk Storage), providing 99.8% system availability. *EDS Australia*, provides IT services, manages databases and security. *Telstra* provides data telecommunications services with 99.8% network availability via *HSNet*, an IP Network for Health. 8 major **Public Metropolitan Hospitals** are connected to OACIS through HSNet. *The OACIS openEHR format uses HL7 messaging and LOINC (Logic Observation Identifiers - Names and Codes) codesets*.

The **Separation summary** (encounter details, clinical synopsis, hospital appointments, laboratory results, radiology reports, discharge medications, etc.) from ODR is made available to GPs, Pharmacies and Private service providers though secured Internet access. *The GPs openEHR format uses GEHR*.

After obtaining consumer consent, the **Health*Connect* summary** (event summaries, most recent treatment, separation summary, etc.) from ODR is made available to Health*Connect* participants though secured Internet access. *The* Health*Connect openEHR format uses CEN EN 13606-1*.

Gateway++ and EMPI: different systems (Theatre, Lab, Radiology, Pathology, ADT, etc.) are integrated by **Cloverleaf**, an integration engine to interact with Gateway++. The EMPI matches and merges patient demographic information. *Gateway++/EMPI (replicated) run under two Sun Microsystems E4500 servers* (10 CPUs at 400 MHz each, 5 GB Memory, 450 GB Disk Storage), providing 99.8% system availability.

The Oacis Programme comprises a series of ***integrated projects*** connecting hospitals, health professionals and the community to benefit health service delivery in South Australia via information technology:

- **Clinical Display:** provides a single point of access to integrated patient demographics, patient encounters, outpatient appointments, patient medications, laboratory results and radiology results. The Clinical Display allows the clinician to view a comprehensive history in real time that charts and displays information and results without having to wait for paper records to be delivered.
- **Clinical Order Management:** is an electronic ordering system for pharmaceutical, diagnostic, therapeutic, medical and surgical patient services and incorporates best practice information into multi-disciplinary order sets. The **Pharmacy Order Management** module is an electronic ordering system for prescribing inpatient, outpatient and discharge medications utilising a standard format that will improve the accuracy of ordering and reduce medication delays and errors.
- **Separation Summary:** communicates information from the clinical information system to GPs and other providers about a patient's hospital encounter to ensure continuity of ongoing health care. The South Australian Divisions of General Practitioners Inc. (SADI) developed a central, accurate and up-to-date Registry of a GPs contact details to facilitate the delivery of reliable and timely patient communication from hospitals to the GPs.
- **Clinical Reporting Repository (CRR):** holds clinical data held across the patient population in the ODR i.e. holds the entire clinical event details. CRR reduces traffic congestion on ODR as query, analysis, report generation, secondary research, etc. can be carried on CRR. The South Australia's CRR implementation has contributed to OACIS (DINMAR).

HOW 'CHANGE' WAS MANAGED UNDER THE OACIS PROGRAMME

Fig. 6 below shows statistics of the Oacis Programme:

	Mar'00	Mar'03	Apr'03	May'03	Jun'03	Sept'03	Jan'04	Feb'04	Mar'04	Apr'04
users	250	8,400		8,500	9,500					10,800
clinical units	-	70+								
sites	4	7		8						
average daily beds available	-	2,428						2,626		
accident and emergency attendance per annum	-	3,04,995						3,09,971		
outpatients visits per annum	-	15,24,148						13,08,903		
inpatients separations per annum	-	2,43,452								
users trained	-				9,069	9,567	10,093	10,476	10,717	10,895
active users	-				2,535	3,005	3,175	3,348	3,517	3,408
hours of usage	-				40,838	53,128	53,154	67,943	76,551	67,911
average monthly hours of usage	-				16.10	17.68	16.74	20.29	21.77	19.93

Figure 6. Statistics of the Oacis Programme.

Ref. [11] The Oacis Programme has a large range of skilled staff with backgrounds in management, administration, information technology, nursing, and clinical delivery. Each hospital or health service involved in the Programme has a local team of site coordinators and clinical sponsors who coordinate and support the implementation of Oacis at their site. This includes liaising with local key decision makers and stakeholders, testing the functionality of applications and providing user training and support. The Oacis Programme teams include: Programme Management Office, Clinical Sponsors, Site Coordinators, Training, Communications, Maintenance & Systems Support, Interface Development, Clinical Order Management Implementation, Separation Summary Implementation, Enterprise-wide Master Patient Index, and Data Warehousing.

Ref. [12] Patients are issued with smart cards that contain and log pertinent data. Patients now log in to renal care facilities with a smart card that automatically records their weight and other details, rather than having to capture this in a labour intensive fashion.

Total investment of $95 million for a period of 5 years (initial $30 million software cost + $65 million). Capital expenditure on ICT equipment accounted for some 25-30% of total costs, externally purchased services were 20%, internal project costs were approximately 30%, with the balance in training costs.

Lessons learned:

- Long term project should be adequately funded;
- Stakeholders should be involved from an early stage;
- Providing early system benefits to those involved in the system design and implementation as an incentive;
- Making each unit aware of being a part of the project by sharing information across the system; and
- Fostering teamwork for easy implementation of the project.

AREAS WHERE THE OACIS PROGRAMME INFLUENCES HEALTH*CONNECT*

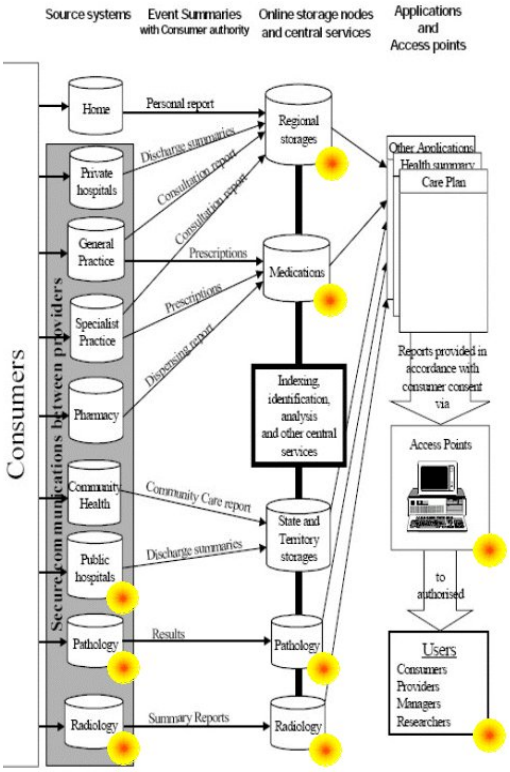

Figure 7. Areas where the Oacis Programme influences Health*Connect*.

Ref. [13, 8] Fig. 7 above highlights areas where the Oacis Programme influences Health*Connect*.

- The Oacis Programme, implemented in Adelaide **Metropolitan Public hospitals**, began with a focus in improving acute care (renal units), involving both public and private **radiology** and **pathology** centres.
- Followed by the GPCG initiative of converting Oacis EHR to GEHR and vice versa, the DHS and SADI jointly developed a statewide GP register. The Separation Summaries were extracted from ODR for GPs and other providers (private) to facilitate the delivery of reliable and timely patient communication from hospitals to ensure **continuity of ongoing health care**.
- The Health*Connect*'s Clinical Information Project (HC-CIP) was for developing a framework for defining **clinical information capture** (in the form of 'event summaries' and representation (lists, views and reports) in shared EHRs. Where in, the initial health profile, GP consultation, **hospital discharge summary, pathology, and imaging** event summaries were identified as immediate priorities.
- The state of South Australia uses electronic signatures for **drug prescribing and also for procurement**.
- Privacy and Confidentiality was guaranteed under Oacis Programme by adopting the **Code of Fair Information Practice** combined with **Role-based access** guidelines to the Oacis system.
- Based on the above experiences, the **DHS is represented on the Health*Connect* Board**.

OACIS PROGRAMME VS HEALTH*CONNECT*

Ref. [14] Table 1 below compares the Oacis Programme with Health*Connect*.

TABLE 1
OACIS PROGRAMME VS HEALTH*CONNECT*

	Oacis Programme	**Health*Connect***
What?	Hospital based clinical information management for renal patients	National system of EHR to improve flow of information across the health sector
Focus	Better decision making in acute care	Providing valuable information for health sector
Propagators	Patient centric and provider/clinicians driven	Commonwealth and State and Territory governments driven
Scope	Limited to Adelaide metropolitan public hospitals + Some GPs and Private units	Throughout Australia
Collection	Comprehensive encounter information from source systems	Brief event summaries from point of care
Storage	Held in central storage repository	Held at regional storage service close to point of care
Ownership/ Funding	South Australian public health system	Jointly Australian, State and Territory governments
Architecture	Client-server under Intranet + Some have secured web access (separation summaries)	Web based under secured network using PKI
OpenEHR	HL7 messaging + LOINC codesets	CEN EN 13606-1 (CEN archetypes or HL7 templates)
Consumer	▪ Consumer not registered ▪ Implied consent model used just as paper based records ▪ Medical records are linked by matching patient demographic information ▪ Access to information under Freedom of Information act	▪ Voluntary participation, Unique ID after registration ▪ Information storage/disclosure with individual's consent ▪ Event summaries and medication details are linked by using consumer ID ▪ Complete control and on-line access to information
Provider	▪ Unique logon ID for all providers involved in patient care ▪ GP registry prepared by SADI ▪ Providers to follow set of Information Privacy Principles (Code of Fair Information Practice) based on Privacy Act 1988 ▪ Only authorized providers will password authentication (based on role and site) can access information ▪ Only required information connected with patient care is made available	▪ Voluntary participation, Unique ID after registration ▪ National provider directory being prepared at WA ▪ Providers to follow 10 National Privacy Principles till National Health Privacy Code is introduced ▪ With patient's consent, only authorized providers can access information ▪ With patient's consent, only required information connected with patient care is made available

CONCLUSION

*v*OACIS™, the EHR solution from DINMAR (Canada) is certainly one of the robust CIS solutions currently available in the market.

The Oacis Programme can be concluded as a state of the art implementation by the DHS because:

- The Oacis Programme was not just a mere IT project but a strategic change initiative;
- Oacis links other systems and provides a longitudinal patient record (EHR);
- The openEHR format of Oacis clearly addresses issues related to interoperability;
- The Oacis 24 x 7 availability has demonstrated its utility; and
- Confirming to the state jurisdiction, Oacis has also handled health data related Privacy and Confidentiality issues.

ACKNOWLEDGMENT

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HEAL framework: A variation of SSM

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Abstract- In Health, as indeed in all business sectors, dynamic developments in technology continue to drive challenging opportunities for paradigm shifts in service delivery. Change Managers need to seek the best approaches, methodologies and frameworks for success and it is in this context that Soft Systems Methodology (SSM) has considerable potential. This paper proposes a generic framework (HEAL) to understand and address Health Care Information System (HCIS) implementation issues. This is the last paper among a series of two papers; and this framework was put forward for the focus group discussion "Soft Systems Methodology for achieving successful technological adoption outcomes- History & Future" at the School of Public Health, Curtin University of Technology, Perth (WA).

***Keywords*- Soft Systems Methodology, SSM.**

INTRODUCTION

Ref. [1] Soft Systems Methodology (SSM, Checkland, late 1970's), a socio-technical tool, has found a place in dealing with many complex situations. In Health, as indeed in all business sectors, dynamic developments in technology continue to drive challenging opportunities for paradigm shifts in service delivery. Change Managers need to seek the best approaches, methodologies and frameworks for success and it is in this context that SSM has considerable potential.

There are some known issues connected with implementation and use of Health Care Information Systems (HCIS). Inspired by Checkland's SSM, this paper proposes *HEAL framework*, a generic tool to aid the management in deeply understanding organisational problems and congruously addressing the same considering the organisation's potential.

HCIS ISSUES

Some well-known HCIS issues are cited below:

Ref. [2] Four main areas of HCIS failure:

- Total failure – a system is never implemented or is implemented but immediately abandoned.
- Partial failure – initiatives in which major goals are unattained or in which there are significant undesirable outcomes.
- Sustainability failure – an initiative that succeeds initially but then fails after a year or so.
- Replication failure – an initiative that succeeds in its pilot location but cannot be repeated elsewhere.

The greater the change gaps between current realities and the design conceptions of a new HCIS, the greater the risk of failure. A successful HCIS will be one that tends to match its environment in relation to technical, social and organisational factors, these later including the perceptions of key stakeholders.

Ref. [3] Causes of systems failures can broadly be grouped into three categories:

- Requirements engineering
- Insufficient resources
- Human intervention

When systems fail, they can cause havoc everywhere. They affect the organisation involved in creating, maintaining and using them and they can have profound effect on the people involved, directly or indirectly. Being able to quickly and cost-effectively provide complex software solutions of good quality has become critical in differentiating success from failure.

Ref. [4] Four domains of deep-seated problems in health care:

- Policy formulation and implementation
- Organisational and Institutional
- Clinical service and Clinical unit
- Clinician-patient interface

Solution had limited success because we continue to have people and groups in healthcare who pursue self-interest through exercising personal power and influence, mobilise economic strategies, advanced biomedical/scientific responses or proffer the managerial toolkit. The proposed SSM+ is a 16-staged framework approach from problem identification to problem resolution and then solution implementation.

Ref. [5] The journey to reinvent healthcare begins by recognising that to design health services, we need to understand systems. Together people, tools, and conversations – these form the 'system'.

Four rules for the new socio-technical informatics, which could help guide the active design of our health services:

- Technical systems have social consequences.
- Social systems have technical consequences.
- We don't design technology; we design socio-technical systems.
- To design socio-technical systems, we must understand how people and technologies interact.

Ref. [6] Clinicians were using Downs Syndrome Screening Software program to calculate the risk factor of pregnant women in the Immunology Department of the Sheffield Northern General Hospital. This originally GWBasic based software, operating on a dedicated PC had undergone changes, had been moved between two hospitals, had been setup on different operating systems, and had been maintained either in-house by people with self-acquired IT skills, or external consultants with self-acquired IT skills. Resulting in 158 women wrongly screened as being at low risk; out of which, 4 Down's syndrome pregnancies were undetected; 2 women gave birth of babies with Down's syndrome; while, 2 women terminated their pregnancies.

Software failure was mainly a result of organisational and managerial decision and actions taken during the development and use of the software system. Organisational problems not only contributed to the failure of the software, but also allowed it to produce false results.

HEAL FRAMEWORK

HEAL, inspired by Checkland's SSM, is a generic framework for deeply understanding organisational problems and congruously addressing the same considering the organisation's potential. HEAL is a 4 staged, 11 stepped iterative framework:

- **H**elp understanding the problem
- **E**nquire thoroughly
- **A**pply judiciously
- **L**earn continuously

L. [Stage-1] Help understanding the problem

1. Get an understanding of the problem-
   a. WHO is involved at WHICH capacity and WHERE;
   b. WHAT are the doing WHEN and WHY; and
   c. HOW are they doing it?

   This should cover all ***4 Ps*** [People, Process, Perspectives, and Power].

M. [Stage-2] Enquire thoroughly

2. Collect as much information as possible based on technical, socio-cultural and political lines to structure the problem by-
   a. Doing reading and observation;
   b. Conducting individual interviews and group discussions; and
   c. Using objective and subjective type questionnaires.

   This should cover all ***8 Ms*** [Mentor, Machine, Method, Material, Motive, Motivation, Metrics (for mentors and methods), and Measurement] plus additionally ***4 Ms*** [Maturity (scale 1 to 5), Mobility (scale 1 to 5), Manipulability (scale 1 to 5), and Manoeuvrability (scale 1 to 5)]

3. Generate problem tree to know more about involved human activities, refer Fig. 1 below:

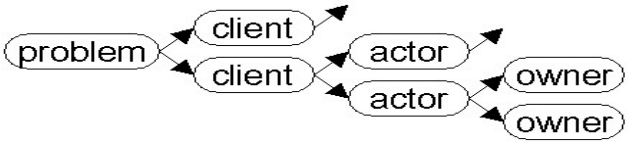

Figure 1. Problem tree.

4. Develop Rich picture to express the structured problem.
5. Carry out Situation analysis (SWOT analysis), refer Fig. 2 below:

INTERNAL	**STRENGTHS** Internal positive aspects that are under control and upon which you may capitalize in planning.	**WEAKNESSES** Internal negative aspects that are under your control and that you may plan to improve.
EXTERNAL	**OPPORTUNITIES** External positive conditions that you do not control but of which you can plan to take advantage.	**THREATS** External negative conditions that you do not control but the effect of which you may be able to lessen.

Figure 2. SWOT.

N. [Stage-3] Apply judiciously

6. Develop Root definitions and do ***CATWOE*** analysis of relevant systems-
   a. Root definition is a short textual definition of the aims and means of systems to be modelled (not that of real world)

   "A system to do ___ [WHAT (short term aim of system)];
   By means of ___ [HOW (means (not method) for achieving the system)];
   In order to ___ [WHY (long term aim of the system)]."
   b. CATWOE analysis adds to the root definition thereby giving more comprehensive meaning to the relevant system, refer Fig. 3 below:

C	CUSTOMERS – the beneficiaries or the victims of T
A	ACTORS – those who would do T
T	TRANSFORMATION process – conversion of input to output
W	WELTANSCHAUUNG – the worldview that makes the T meaningful in context
O	OWNERS – those who could stop T
E	ENVIRONMENT – elements outside the system which are taken as given

Figure 3. CATWOE.

"A certain transformation (process) is performed in a certain atmosphere (weltanschauung);
It is performed for customers (beneficiaries/victims) by actors; and
The activity is ultimately controlled or paid by the owners, and occurs within an environment."

7. Generate conceptual model(s) for each root definition, refer Fig. 4 below:

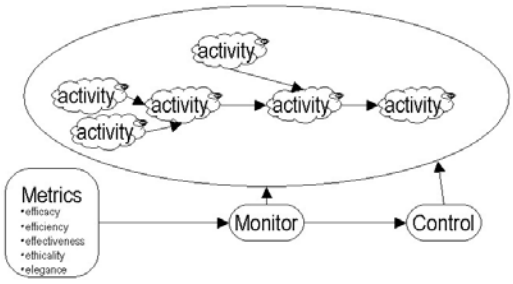

Figure 4. Conceptual model.

a. Use 'active verbs' and 'measurable nouns' to describe activities sufficient for covering the root definition;
b. Clearly show the sequence and dependability of activities;
c. Define metrics based on ***5 Es*** [Efficacy, Efficiency, Effectiveness, Ethicality, and Elegance] for each conceptual model for it's monitoring and control; and
d. Develop rich picture(s) for each conceptual model, at least one for each conceptual model.

8. Compare conceptual (could-be) models with real world-
   a. Use rich pictures obtained from step 4 and step 7;
   b. Find out gaps between real world (step 4) and proposed could-be models for each activity involved, refer Fig. 5 below:

Activity	Current Model		Proposed Model		Gaps
	Activity description	Metrics	Activity description	Metrics	9 Ms
1	-	-	-	-	-
2	-	-	-	-	-
.	-	-	-	-	-
.	-	-	-	-	-

Figure 5. Gap analysis.

The gap analysis should contain all ***8 Ms*** of step 2 plus an additional ***M*** [Money]; and
It should also give an idea of ***3 Rs*** [Reorganising, Restructuring, and Reengineering] for the activities and their possible impact on organisation.

9. Structure a debate among various stakeholders for arriving at an agreeable (would-be) model by-
   a. Use rich pictures of conceptual models obtained in step 7 and gap analysis obtained in step 8;
   b. Carry out situational analysis (TOWS interaction matrices) on SWOT matrix obtained in step 2, refer Fig. 6 and Fig. 7 below:

Internal Factors / External Factors	List Internal Strengths (S)	List Internal Weaknesses (W)
List External Opportunities (O)	SO : Maxi - Maxi	WO : Mini - Maxi
List External Threats (T)	ST : Maxi - Mini	WT : Mini - Mini

Figure 6.TOWS interaction matrices.

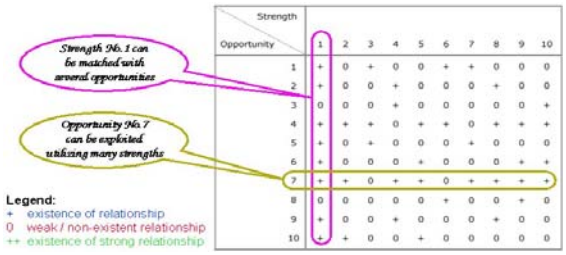

Figure 7. Strength Vs Opportunity matrix.

c. Get additional ***M*** [Mandate] on the would-be model; and
d. Incorporate systemically desirable and culturally feasible agreed upon changes in the would-be model.

10. Prepare a change plan, refer Fig. 8 below and implement the would-be model:

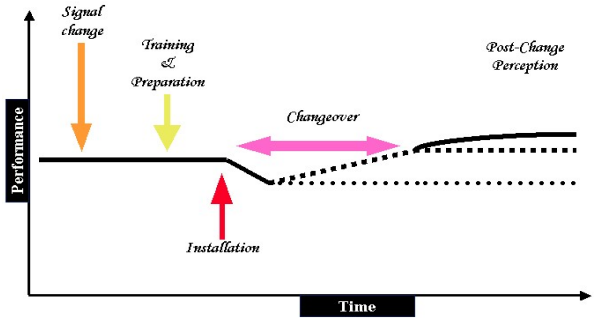

Figure 8. Change curve.

a. The change should be gradually and cautiously implemented;
b. Adequate training and resources should be provided; and

The model should be evaluated taking change into consideration.

O. [Stage-4] Learn continuously

11. Document lessons learnt by applying HEAL framework. The new system obtained, again being a human activity system, it becomes iterative. It should further assist ***3 Ps*** [Practioners, People, and Promulgators].

CONCLUSION

Ref. [7] Organisations that will truly excel in the future will be the organisations that discover how to top peoples commitment and capacity to learn at all levels in an organisation.

The proposed HEAL framework will not only aid the management in resolving its deep-rooted complex problems, but it can also help toward organisation learning.

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The author would like to thank the members of the Centre for Health Informatics Research of Curtin University of Technology, Perth (Australia) for the support provided during

the author's short-term period of stay there as 'Adjunct Research Fellow'.

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Healthcare and Nutrition: Big Mother Is Watching You

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Abstract Tell me what kind of food you eat, and I will tell you what kind of man you are ! Since 1825 the Brillat-Savarin's, the famous gastronomy French author, reflections on the matter people have nourished represent the most trenchant discussion of nutrition and its effects on trenchermen. Moreover nowadays it has been demonstrated that nutrition has a strong and deep relationship with healthcare, with the man's joy and in general with the quality of life. This relationship between food and healthcare is becoming day by day more important especially because with the modern technologies (Pharmaceutical / Information Communication Technologies-ICT / Diagnostic / Biotechnologies) is possible to monitor/manage not only what we eat but also the effects.

This trend is striking symptom of change which we determine in the present and which give us information for our lives in the future. For example over the past few years, we've seen that organic products have moved into the social mainstream . Nowadays organic foods are going even further: organic products are increasingly becoming a central element of a lifestyle which sets ambitious targets. Today 's new consumers, especially in EU-European Union are characterised by "I 'll have that & that & that...." thinking:

- the greatest possible enjoyment and in harmony with nature
- the greatest possible awareness of myself, my personal development and in the interests of my environment and social circle
- the highest possible product quality and meeting clear ethical standards
- the highest quality in a healthy way.

In order to keep pace with this very interesting change in social values ,it is not enough to simply wait for the next trend or wave of well-being .The food industry and healthcare sector currently has the opportunity to be a frontrunner in a new social development .This is why food and healthcare are becoming nowadays very strategic sector for industries especially for Biotechnologies, Pharmaceutical and ICT ones. In fact the ICT industries in these sectors are very close to the telemedicine and preventive telemedicine companies. From this point of view, with a preventive and holistic treatment approach, Vox Net put the attention on the food characteristics knowledge matched with the telemedicine field and the economical/financial problems in managing "foods culture" and "foods professional services" for schools, big catering companies and hospitals. In Vox Net we believe this is probably the real frontier of healthcare also because the populations of most western countries and EU are now rapidly aging. In spite of the increase in health-consciousness, a growing number of adults are suffering from so-called diseases of affluence. As a result there is widespread interest in the potential for using diet to lower the risk of common diseases like coronary heart disease, diabetes, cancer and osteoporosis. Younger people with busy lifestyles are also keen to invest in their personal health. They want quick, convenient meals that help to maintain their well-being or even prevent illness and, at the same time, taste good. Therefore there is a clear demand for healthy alternatives that are tasty and easy to make.

For sure in Vox Net we used a collaborative approach that probably is a relatively young discipline which brings together aspects of economics, psychology, sociology, food science and ICT research. Furthermore the interdisciplinary work approach is demanding and it helps us to incorporate new points of view when we plan our experimentsand analyse the results.

Conclusions: In future we will assume more responsibility for ourselves and for the environment. Healthcare, healthy food, a good balance between work and leisure, and a life in harmony with nature are the key concepts in the future. Telemedicine and "good foods" has a lot to offer in response to these consumer trends. Moreover, about dietary and "gastronomy" ICT applications there is a consensus that is very helpful to provided healthcare services at home. For this reason the Vox Net developed web platforms that fit these needs.

Finally, if future is the result of a negotiation where we should, at least, have a seat and a vote let's all sit down at the beautiful, old, story-telling table winning next challenges. It's time to start!

Keywords: Nutrition, New Trends, Healthy Life, Web Platforms.

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An advanced connectivity for distributed and heterogeneous clinical databases

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Abstract- In medicine a clinical entity is usually represented by different synonymous keywords, meaning that physicians are dealing with a rapidly changing, unstructured and qualitatively heterogeneous data sharing environment while trying to pick up the needed data of decision making. In recent years, ontologies have been adopted in many scientific communities as a way to share, re-use and process domain knowledge by using a variety of formats including RDF(S), OWL, and XML Schema's. However current structures cannot satisfy the new desiderata of Medical Data Structures, such as the demand for re-use and sharing patient's data, their transmission and the need of semantic-based criteria in order to reduce the "noise" of less relevant medical data. The aim of this work is both to review fundamental theoretical ontology issues and propose a java oriented structure for data and knowledge management by using metadata databases combined with multi-tier architecture and agent software. The proposed structure may promote integration data exchange amongst heterogeneous nodes of medical grid environment. This dynamic design is associated to schema descriptions maintained in catalogues and medical repository entries, providing data about both stored data and health care department's processes associated with them.

Keywords: JAXT, agent, Ontology, knowledge, Collaboration, Metadata, XML

I. INTRODUCTION

Healthcare has been recognized as one of the most important areas for enterprise applications and services. Presently, data technologists and structures engineers all over the world are working in order to achieve better efficiency and quality of service in various sectors of healthcare, such as data and knowledge management. [1,2]

Current requirements in this sector demand the integration of data, human-machine, and healthcare technologies [3]. Several projects have put the focus on the data classification including UMLS[6], ICD-10 [7] and SNOMED.[8] However, most of them cannot satisfy entirely the desiderata of current healthcare requirements relative to data and knowledge management, due to problems concerning the linguistic nature, and the description logics [12]. These projects use ontologies that have been or are being developed to meet specific needs, each with its own point of view, suitable to the purpose it has been developed for [12, 13]. There is yet no common ontology. On the other hand most of the existing structures run on heterogeneous computing environments utilizing different structures (e.g. architecture, ontology, etc.). As a result, physicians usually are forced to deal with a rapidly changing, unstructured and qualitatively heterogeneous data management applications while trying to locate the needed data.

Current requirements demand services able to i) deal effectively with existing great amount of data stored in various distributed repositories [12] ii) reduce physicians spending time to manage and synthesize data [10] iii) reduce costs arisen by storing a number of clinical transcripts in a number of distributed database due to the lack of integrated scheme able to connect efficiently the required data. [11]

Our work put the focus on a collaborative grid development to support data access utilizing efficiently distributed heterogeneous unstructured sources. The proposed structure is based on emerging technologies (i.e. JAVA^{TM})[16] and agent software.[4] Agents are autonomous, social, reactive, and proactive software[5] which provide a range of promising techniques to support the requirements of data and knowledge management of the healthcare sector.[3] This software addresses the issue of data interoperability at a semantic level.

The presented issue utilizes data and software providing interoperability between distributed databases by modelling at different levels of abstraction such as physical, data-type, specification level, and semantic forms interoperability.

II. MATERIALS AND METHODS

To provide easy management (retrieval, integration and evaluation) of multimodal medical data a web browser environment, distributed application technologies and Java programming were used to develop a structure based on software agents [14, 15]. This structure manages connections and queries to heterogeneous remote databases and file structures containing efficient clinical data. The client side is a Java applet running in a web browser that provides a

friendly medical user interface to perform queries on data and integrate and visualize properly the various query results in order to increase, day by day the structure knowledge. [23]

A set of tools based on Java enables data processing, data analyzing and data retrieving, quantifying their features in different regions of interest. The Java technology makes the developed prototype to be managed easily in a centralized form and be provided in each site where an intranet connection can be located.

The proposed structure supports this requirement by using a multi-tier architecture and utilizing in parallel a number of distributed XML metadata sources, agent software and a semantic scheme. The structure has been implemented entirely by using the network programming platform, called JXTA (JAVA ™ Tech) [16] that converts unstructured data, to a uniform way.

Especially the structure utilizes a physician front-end web based interface responding to a P2P approach implemented on the open source platform JXTA allowing collaboration of distributed computing applications. In order to provide personalized services and self-management capabilities to the implemented network, agent structures have been employed. Generally the structure consists of a) a Front End Web Interface, b) Physician Ontology Agents, c) Local Medical Metadata, d) Query Analyzer and e) Upper level ontology agent based on P2P network using a JXTA platform. The structure architecture can be seen in figure 1

In the following sections we will try to give a brief description of the structure building blocks and the applied technologies.

Front End Web Interface

Using a friendly front end interface, called medical metadata generator, Fig 2 the physician is able to insert data characteristics (i.e. clinical exams, diagnosis, vital sign variables etc) performing a query necessary for medical data-generation, search structure and e-functionalities (i.e. clinical data exchange and management). This layer is actually a web domain resulting the generation of medical metadata and ontology translation of the performed queries enabling access to the structure functions.

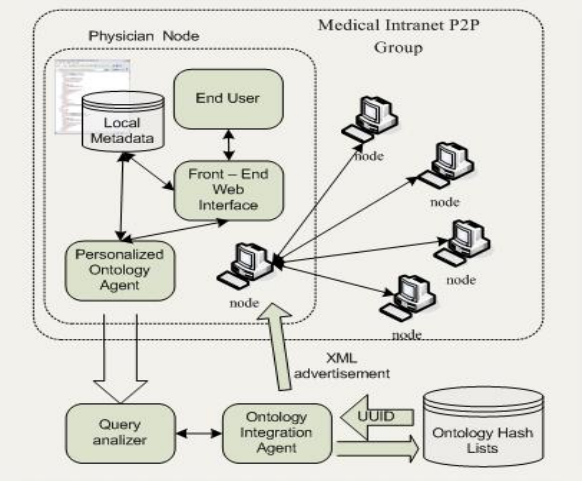

Figure 1 The Proposed Structure

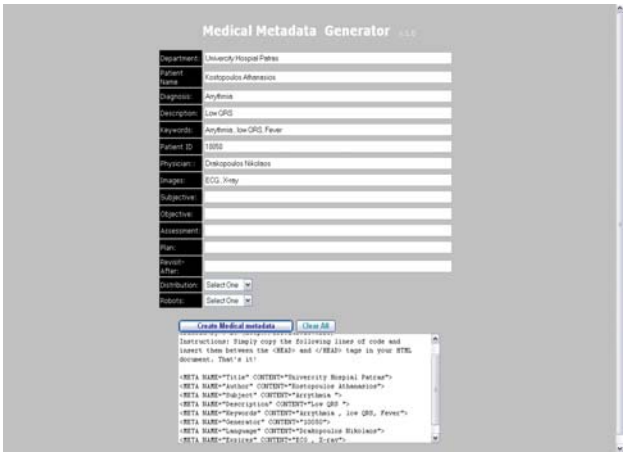

Fig 2 Medical Metadata Generator Interface

Physician ontology agents

Ontologies provided by physician's side are managed automatically by a physician oriented medical ontology agent called physicians ontology agent (POA). The POA agent interacts with the physicians to elicit their preferences. These preferences include the relative importance and attribution of terms used to pose queries as well as other preferences to be used by the upper level ontology agent at the second level. Additionally, the agent accesses domain ontology (i.e. according to physician's terminology, language etc) specified for example in Web Ontology Language (OWL) [18] using terms according to the user-specified preferences. OWL Ontologies can be built by using the Protégé-OWL Plug-in [9]. The domain ontology is able to updated itself and accommodate new concepts and relationships so it will be further personalized while running the agent structure.

Local Metadata

The generated metadata are stored in a local medical metadata database that is accessible from other nodes that are members of the proposed network.

Query analyzer

The physician indicates an initial query to the query analyzer. This module, in turn, consults the physician ontology agent to refine or generalize the query based on the semantic mediation provided by the available ontology domain. Once a query is specified by means of interactions among the agents the query analyzer sends the refined query to the upper level ontology agent. This involves semantic mediation of terminology used in the domain ontology model. Also, query translation is needed to retrieve data from the intended heterogeneous sources.

Ontology Hash List

The ontology hash list [19] is responsible for managing both a list of the medical metadata stored in every single node and the addresses of the related nodes. In this way the heterogeneous distributed data bases due to agents are listed in a relative and homogeneous encoding. In this way an integration of all metadata with a list encryption is achieved. Every time a new node becomes a member of the P2P

network the ontology hash list is updated, refreshing the list. As medical exams are an every day procedure, ontology hash list is periodically updated with these additional data changes, of every node.

Upper level Ontology agent

The ontology data as well as queries produced by the upper agents are managed by the upper level ontology agent. This agent periodically examines the ontology hash list performing relations among the stored medical records. This leads in creating an upper level list that includes associated ontologies followed by the degree of association as well as the name or address of the node that includes the associated metadata. The query results, managed by the upper level ontology are sent to the node that initially performed the query. The node can now communicate with other nodes and exchange information. This information is visual from the Front End Interface providing the physician with the required medical information or patients records. By the physicians final selection(s) the agent 'learns' and updates itself for further improvement of the results. By doing this, the agent is able to reform the association and the degree of association between the ontologies.

Proposed Schema

In this paper we propose an Intranet schema composed of independent hospital nodes based on P2P topology [22]. Using P2P topologies a client can advertise, send, or receive files interacting with another client. In this P2P topology each node uses a subset of files (local medical database) and has access to files of all nodes in the structure (distributed medical databases). This will establish a direct communication and collaboration (mostly data and knowledge sharing) between nodes. The whole structure consists of peer to peer (P2P) nodes and societies of adaptive agents that where mentioned above that travel through this network, interacting with other nodes and cooperating with agents in order to integrate or solve medical ontological problems. Nodes handle requests, originated by local physicians, using the above agent mechanisms trying to satisfy query request. Autonomous agents can observe their environment and perform simple local computations leading to actions based on these observations. The actions of these agents can modify the environment. The implemented structure is developed in JAVA and more specifically is based on JXTA technology [16,17], which is an open source P2P project promoted by SUN Microstructures. JXTA aims to establish a network-programming platform for P2P structures by identifying a small set of basic facilities necessary to support P2P applications and provide them as building blocks for higher-level functions. When a node boots in JXTA environment it a) becomes a member of the Medical Intranet Peer Group b) can discover and communicate with other peers in this group exchanging medical data, information and knowledge. Every node is assigned a unique ID called universally unique identifier (UUID) [20]. A UUID is 128 bits long, and can guarantee uniqueness. The UUID is obtained by the upper level ontology agent within an advertisement. An advertisement is an XML structured document that names, describes, and publishes the existence of a resource, such as a peer. The advertisement is diverted to the node that initially performed a query enabling P2P connectivity through the UUIDs.

The benefits of basing our implementation on JXTA technology are that a) it provides the possibility of using different transport layers for communication, including TCP/IP and HTTP, b) it is capable of handling firewall and NAT related problems, c) JXTA protocols are completely hardware and language independent, d) a protocol called peer discovery protocol (PDP) is used in order to allow a peer to find other peers, groups, resources, or services.

III. Discussion

Nowadays, medicine is dealing with a great volume of information. Information concerning patient's history, symptoms, functions and lifestyle, information about diseases, diagnoses, drugs, and treatment methods play an ever-increasing role.

The challenge faced by physicians is to find and utilize the relevant data at the right time. However, current systems can't keep up with the increasing rate of medical information. Therefore there is an absolute need for 'smarter' and self upgrading software. In this paper we have highlighted the central role of the agent software and proposed a structure to improve the data and knowledge management within a healthcare grid. This agent software requires personalization, proactivity, context-sensitivity and collaboration. Medical structures such as the presented will streamline user interfaces and enable more sophisticated communication and problem-solving. The proposed structure facilitates metadata generation and uses self updating agents that can integrate different ontologies. The P2P network allows physician to avoid the WWW chaos and attempts to create a closed medical information system that withdraws medical information using a metadata mirror based on personal ontology.

Eventually we believe that the implemented, or similar, structures can become the physicians effective tool for browsing, querying, visualizing and evaluating the desired medical data in a healthcare environment.

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CARAMEL: A plugin-architecture for the secure integration of standards in medical information systems

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Abstract Data Cleaning, originally an essential task of the ETL process, has increasingly become a key role in data quality management. Especially in public health care systems data quality is very important due to the decisions being made and prevention programs being started based on these data. This paper gives an overview over common data cleaning problems and presents an application, which provides solutions for these problems with respect to specific public health care requirements. We give a new kind of classification for data cleaning problems and show some future research tasks for the development of CARAMEL and for data cleaning.

I. INTRODUCTION

The Law about the epidemiological Cancer Registry of Lower Saxony (GEKN) [2] defines that medics and pathologists and other facilities are able to report diagnosed cancer diseases. The cancer registries core function is to identify conspicuities in all these reported cancers diseases and the distribution of the diseases. When pattern are being recognized, one can start appropriate prevention tasks. Therefore the epidemiological data, which is contained in the reports, is analyzed statistically.

The reports contain data which are based on many different standards, because a couple of dissimilar information systems are being used in surgeries or pathologies. These systems all have various interfaces, which produce data corresponding to different standards.

When the data are being loaded into the registries central database, one has to focus on the data quality. This is a very important task, because the quality of the accomplished analyses directly depends on the quality of the data ("garbage in, garbage out" [11]). Due to problems with incompatible standards or human errors, data may contain dirty values, missing values or else. These errors have to be corrected automatically, whenever possible.

This paper introduces the architecture and the core tasks of the cancer registry in the next section and focuses especially on the application CARAMEL (CARLOS Attaching Multiple Existing Local Registration Units) in section three. The following section explains some data quality problems, which should be solved by data cleaning tasks. The next section explains how these cleaning problems are being solved by CARAMEL and which architecture is being used in order to support these cleaning problems. After having a look on related work the paper ends with a conclusion and an outlook on future work.

II. THE CANCER REGISTRY

The development and operation of the Cancer Registry of Lower Saxony is being supported by the institute OFFIS with the project CARLOS (CAncer Research LOwer Saxony) [6]. The GEKN defines a lot of data protection policies, for example the cancer registry must not be able to recognize to whom the data, which is stored in the registries database, belongs to. This is realized by two physically divided institutions, where the first one only knows about the personal data and the second one only stores the epidemiological data and the diagnoses. In the context of CARLOS a couple of tools were developed and are still being maintained. CARAMEL, which is described in this paper, is used for data integration tasks for different data sources and provides data cleaning functionality. Fig. 1 shows the core task of the application. CARTRUST is a data manipulation tool, which allows medical documentation officers to work directly on the target database in order to manipulate the data and to insert diagnoses and other important, non-trivial data. CARELIS supports record linkage tasks and provides solutions based on best-of methods in order to identify similar data, which refer to the same real-world-entity and performs these tasks on encrypted data. CARESS provides statistical analyses and can

be used to perform medical investigations based on the target database and is able to create annually reports.

Another restriction is that data has to be sent to the registry only in an encrypted way. In order to provide a solution for this requirement, one decided to introduce PGP (Pretty Good Privacy) [7] encryption and decryption methods. Using this technology medics are able to send encrypted data, which can only be decrypted by the cancer registry. On the one hand the Cancer Registry retrieves some kind of files, which belong to different standards and on the other hand it retrieves files which are not described by a standard like comma separated values or paper based forms. BDT [5] for example is a standard with a semantically rich structure. It is based on sets and fields, where a set defines the couple of fields in a set, including the meaning of the set. Each field has a meaning and a predefined structure. dc-pathos [4] is a semantically poor proprietary standard where data is distributed over a couple of files. While one can use scanning and parsing algorithms in order to read the BDT standard, data in the files of the dc-pathos has to be extracted by manually defining the mapping into the database. Other data only exists as a couple of comma-separated values, without any semantics. Some data still is transferred to the cancer registry using paper based forms. These data can be extracted using hardware scanner, which digitize these forms. OCR (Optical Character Recognition) technologies are being used in order to extract the text from the scanned documents. Even these data can be read using hard-wired mappings and text mining tools.

III. Data Cleaning

Extracting data from different data sources is a difficult task. Many problems exist which require data cleaning tasks. This section will introduce these problems and show how current approaches deal with these problems.

Data cleaning, which is also called data cleansing, deals with detecting and removing errors and inconsistencies from data in order to improve the quality of data [11]. These errors and inconsistencies may occur in several data sources like files or they may occur in databases. Errors in databases for instance may result from web-based input forms, which offer free text fields where one is able to enter any data and these data are not being checked properly. User might enter data in the wrong fields, like ZIP Codes in city fields and vice versa, which might cause later applications not to work properly and to produce defective results, whose causes are hard to find. Errors in files may come from broken files, misplaced line feeds, insufficient application interfaces, which produce these files, hardware based errors, maybe caused by broken disks or else.

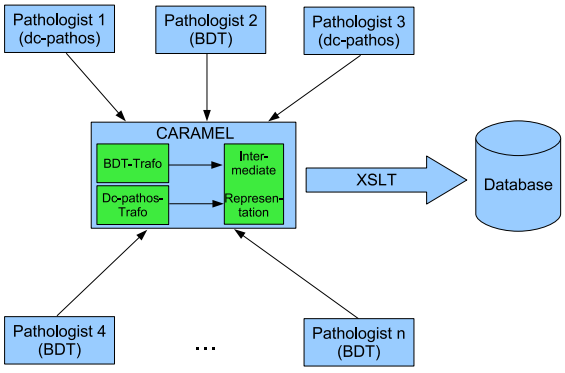

Figure 1. The core task of the application CARAMEL. Different data sources have to be integrated into the Cancer Registries database

We divide data cleaning problems into three categories. Table 1 shows the core challenges in the data cleaning process classified by these categories. The syntactical problems have been studied for a long time [13 - 16] and can be corrected only by analyzing data fields without further knowledge. Duplicates and referential integrity constraints can be found just by having a look on the syntactical structure. Semantical errors can only be corrected while having a look onto these data and with interpreting these values. Domain specific errors describe data which is only valid in a specific context and can only be corrected using a metamodel. These categories of errors are now being described in detail.

Traditionally data cleaning consists of syntactically analyses of data. Syntactical errors can easily be found when the data is governed by a schema, like data stored in databases or XML-based data. In proprietary file formats, which are not necessarily described or annotated with metadata, one could manually extract the data from the files by using a programming language, or in a more advanced way one might use a description or specification language, as introduced in [16], for instance, which provide quite flexible data access and which can be used in order to describe the data fields, their data types, their possible content and else.

In the syntactical analysis process one can check whether fields contain values which are belonging to the correct data type, like integer values and string values. When users are able to enter data into free text fields, they might enter “M. Marple, 12 High Street, London” in the address field, for instance. Text extraction tools do exist, which allow checking these fields. Compare [17] for an example.

One can even check whether dependent attributes are correct, like a cities’ population figure has to be the sum of the populations of each suburb. These functions can be provided by a database, or, in the case of files, by manually programmed functions.

Databases naturally provide support for checking records for uniqueness with the help of identifier. When integrating different data sources, one has to check this manually because the sources may contain identical data. In [12], A. Monge introduces a duplicate detection system which focuses on this problem. Due to the cancer registries reporting process one can ensure that no duplicate records exist across data sources, but only in a single source, where duplicates can easily be

Data Cleaning Challenges		
Syntactical	Semantically	Domain specific
- value-based problems (illegal, missing, embedded, abbreviated, wrong field) - simple dependencies - uniqueness violations - referential integrity violations	-duplicate detection -domain/range errors - impossible pairs of values - dependencies	- Meaning of values comparable? - reference metamodel compatible?

Table 1. Classification of data cleaning challenges. Challenges are divided into three categories called "syntactical", "semantical" and "domain specific"

found via string comparison. Then the records are being integrated with a generated unique id.

Another critical aspect in data cleaning is the problem of referential integrity violations. Assume a data format, which shall be imported by CARAMEL, which consists of several files, where each file contains data records, and between these records relations do exist. Then one has to ensure the integrity of these data. Simply inserting it into a database and to wait for referential integrity conflicts wouldn't be an elegant solution because one would have to correct these conflicts manually afterwards and might encounter an inconsistent database. Instead the removal or repair of these data sets should be done in the original data source using text analysis tools, which can inspect the sources. These even can provide mechanism for manually modifying the data sets. This approach alleviates the possibility for referential integrity violations in the target database.

The syntactical data cleaning process can be supported by tools like CARAMEL, which can automatically repair standard-based files. These tools can also provide interactive support for manually correcting files with errors, which cannot be repaired automatically and can provide an environment to modify incorrect values. Fig. 2 shows a part of CARAMEL, in which one can directly manipulate broken files. This application acts as the last task in a cleaning process, after tools having automatically repaired files. As one might guess, these tools are not only limited to repair files but are also able to correct databases.

The semantically analysis of data is as important as the syntactically analysis. The syntactical cleaning of data only focuses on unique identifier or unique tuple of data. The semantically duplicate detection focuses on different data sets which still may contain the same data. In [15] this is described as the *"Object Identity Problem"* and the AJAX-framework is introduced, which consists of the four steps *mapping*, *matching*, *clustering* and *merging*. Ranges of values can be checked, which means that only defined values are allowed for some fields. In the case of a field for "currency", for instance, one might only want to allow existing currencies. Missing values can be filled with default values or with user input. One also takes a look at dependencies between pairs of values. When thinking about ZIP Codes and Cities, for instance, one might want to allow only pairs which belong together. Or, in cancer registries, you'd only allow specific localization values for describing breast cancer. In order to support these types of semantically dependencies, an ontological approach [22] is needed, which is a more advanced challenge in data cleaning.

In this approach one has to define ontologies for these critical pairs of values in order to check whether the values are possible pairs or not. Following this ontological approach one reaches data cleaning using domain specific knowledge and metamodels.

Domain specific data cleaning is the most advanced step in the data cleaning process and not yet supported by tools. In this task one takes a look on the compatibility of the data, which is to be integrated. Assume formats which define fields for ICD [18], the international classification of diseases, which exists in more than one version. Then assume a format which only defines a field for the ICD, but not for the version and another format, which defines both values. One has to ensure that these formats can be integrated into the target database using correct values. One also has to ensure that data fields have the same meaning. A format or an application might not know about the ICD and use its own classification. The target databases data schema acts as a kind of metamodel which exactly defines the meaning of each data field. In order to clean the data sources one has to compare the file formats with this metamodel and has to check the meaning of the values.

The data cleaning task can be supported by tools so as not to inspect and correct the values manually. The data cleaning task can be performed corresponding to some kind of metadata, like data types of the target database or attribute range definitions or domain specific ontologies or else. Data Cleaning is a well-known part of Data Warehouses or Data Mining environments [8, 9].

In the context of CARAMEL one can think about *when* to perform the data cleaning tasks:

On the one hand one could do data cleaning *before* extracting the data from the data sources. This has advantages as well as disadvantages: When extracting data from many different sources, one has to implement the cleaning tasks for every format and users have to use the cleaning tools for every source. The programming overhead increases with every new format, too. But when performing the cleaning with the sources, users and tools can use special knowledge about the data. For instance when integrating data from specific medics one knows that they will only send cancer reports belonging to specific diseases.

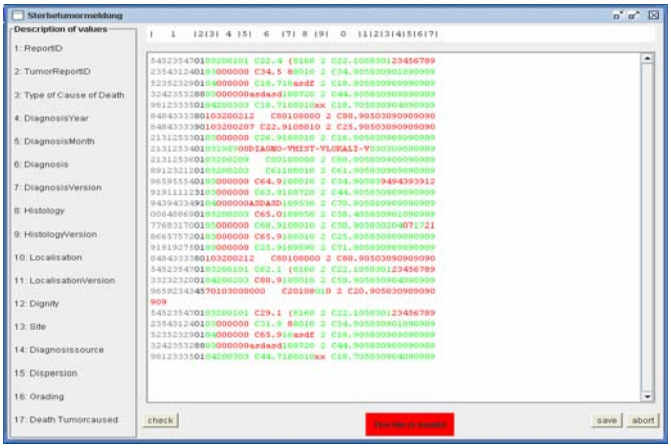

Figure 2. A part of CARAMEL which is able to highlight correct and incorrect values in a file based on a data format, and where data can be corrected interactively

On the other hand one could clean the data *after* extracting, when they are being loaded into a database. In this approach one would only have to implement one data cleaning tool, which can perform on the results of the extraction using an intermediate representation, like fig. 1 shows in the case of CARAMEL. Users would only have to use one tool and would only have to inspect the data once. But domain specific knowledge would get lost in this approach as one wouldn't know the origin of the data anymore.

In order to increase the data quality, one really would use the first approach. In respect to costs and time one instead might use the second approach. A compromise would result in using tools which are able to correct the sources automatically with minimal user input only when necessary and when domain specific knowledge can be used. Other cleaning tasks can be performed after the data has been extracted and transformed into an intermediate representation. Due to legal restrictions the Cancer Registry has to store the data in the target database in a way that it is impossible to recognize the origin of the data. Because of this we had to perform some data cleaning actions for every data source. These actions are cleaning tasks which require knowledge about the data source which will get lost after integrating the data. Other cleaning tasks are performed after the integration into the target database.

IV. The Application CARAMEL

As one can see, the task of loading data is quite fault-prone. Dirty forms, which are being scanned, may produce errors; the character recognition may not work properly and may not be able to read every word or character correctly; the files may violate the standards they are belonging to, which could have been entered by a human being or by an insufficiently implemented interface.

In the German public health care many medical standards exist and medics or pathologists use different information systems which implement one of these standards. Because the cancer registry has to read all these data sources, we decided to develop a plugin-architecture, which may offer a plugin for each standard. Software, which is based on a plugin- cancer registry has to read all these data sources, we decided to develop a plugin-architecture, which may offer a plugin for each standard. Software, which is based on a plugin-architecture, allows using only the part of functionality which is actually needed and supports extending the functionality of the software by adding plugins for new tasks, e.g. for reading files based on new or unknown standards.

Fig. 1 shows the core task of the application. Institutions send their cancer disease reports. For each standard they are using CARAMEL offers a plugin which can read the data. CARAMEL internally transforms the data into an intermediate representation and then uses XSLT (eXtensible Stylesheet Language Transformations) [3] in order to load the data into the database. The flexibility of XSLT allows modifying the scripts during runtime, which is important, because the database schema is being altered frequently and XSLT is very flexible and the templates can be modified without recompiling.

From a more abstract point of view, CARAMEL acts as an ETL-application (*Extract*, *Transform*, and *Load*) [10]. ETL operations are often performed in Data Warehousing processes [1].

Integrating data into an information system is a common ETL-task. Data has to be *extracted* from different data sources like databases or files. In order to extract the elements, which should be extracted, algorithms have to be defined. When the files belong to standards like BDT, one is able to use scanning and parsing technologies in order to extract the data and to create an intermediate representation.

The basic structure of standards from the xDT-format-family is shown in fig. 3: xDT-data packages consist of datasets, which are composed of fields. Fields always contain the structure <length, field identifier, content, CR/LF>. There exist many different datasets, which define different meanings of the field contents. The set "6100" for instance defines patient data, the set "0100" surgery data and "7700" defines

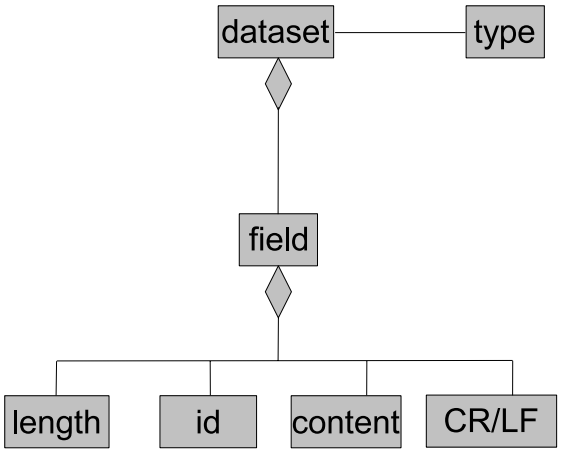

Figure 3. The core structure of the xDT format family. Datasets, which are according to a specific type, consist of a couple of fields, which have a length, an id, some content and a CR/LF

tumor documentation. Each of these datasets defines a couple of field identifier, which represent certain information. The

field "`3102"' from the set "`patient data"' represents the forename of the patient in this way. All these different datasets are associated to the different formats of the family, e.g. the dataset ”tumor documentation” only exists in the format “BDT-Tumordokumentation”.

In order to read BDT- and dc-pathos-corresponding data we developed the plugins "BDTTrafo" and "dc-pathosTrafo". The complexity of the standards necessitated to use scanner and parser technologies to read the files.

We decided to use JFlex [24], a Lexical Analyzer Generator written in Java, which produces Scanner in the Java Language to scan the files.

Fig. 4 shows the State Machine we evolved in order to scan BDT-files. To improve readability only a few transitions are shown here. The State Machine starts in state "0" and tries to read the length information for one data field. This information consists of three digits. When they are read, the machine switches over to state "1". Here one has to divide between a new dataset beginning and a lot of dataset members. As shown above the format knows some datasets (like 0010, 6100, 7700 and many more) and a lot of special data fields for each set. For instance, the dataset 6100 consists of the fields 3101, 3102 and 3103. In fact there are many more data sets and data fields, but these transitions are not shown here.

In State "1" the machine changes to state "2" when it reads dataset definitions and to state "3" when it reads data fields. The machine switches over to state "4" from state "3", when it reads any content for a field and switches over from state "2" when it reads a dataset description. When it reads a line ending in state "4", it changes to state "0" and repeats scanning a file, skipping empty lines, until it reads anything else than a length definition, when it switches over to state "5", where it terminates.

The token JFlex generates while scanning are then parsed by parsers we generated using CUP [25], which is a Parser Generator for Java that can produce parser written in the Java Language.

Similar plugins exist which are able to extract data based on other formats. CARAMEL provides plugins in order to read dc-pathos based files, dBase files, comma separated values (CSV), and even scanned paper based forms. When integrating CSV’s one needs to explicitly define which value stores which piece of information. In order to integrate data which is being read with a hardware scanner, one needs to manually extract the information from the OCR-generated files. Because there is no schema or format for these texts, we had to use a couple of text mining technologies in order to identify and read the relevant data.

All these plugins create an intermediate representation of the source data, shown in fig. 1, where the *transformation*-part of the ETL-process can be done. Here we are able to perform data cleaning tasks. Actually CARAMEL can do all of the syntactical data cleaning actions. It is able to find domain and range errors but still doesn’t have support to find impossible

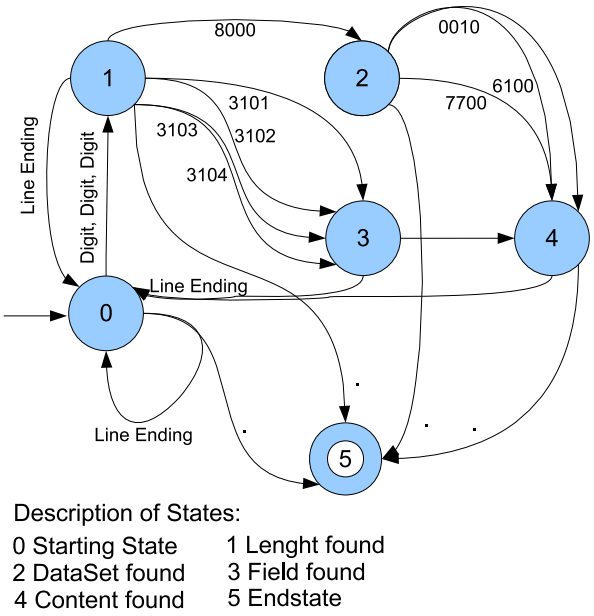

Figure 4. A part of a state machine which can be used in order to scan files which belong to the xDT format family.

pairs of values. The duplicate detection can mostly be done by CARELIS and the domain specific tasks are not yet supported but planned for future extensions.

In order to *load* the data into the target database we created XSLT and some extensions for Xalan, an XSLT-processor. These extensions allow reading from and writing to files, provide SQL-support for XSLT and provide a better variable concept. We created XSLT-scripts, which are able to access the intermediate representation and to store its content in the target database.

V. Related Work

A lot of work has been done in order to perform syntactically data cleaning [11, 14, and 17], which is the oldest task in data cleaning. These approaches mostly focus on data values stored in single data fields, which can be corrected without having a look on other data. Reference [23] focuses on data quality management in Data Warehouse systems.

As shown in the last section, few approaches for semantically data cleaning exist. AJAX [16] focuses on the Object Identifier Problem, which describes the problem of finding unique real world entities in source data, i.e. identifying data tuple which are syntactically different, but semantically identical. Potter’s Wheel [20] is an interactive tool which allows data analysis, data cleaning and transformation. User can specify transformation rules interactively and the system performs actions in order to apply the transformations. Semantic errors are being corrected

using the user's knowledge in manual corrections. The system doesn't have domain knowledge and doesn't provide an interface which enables the user to enter domain specific information.

Little work has been done on ontology-based data cleaning. Reference [19] introduces an approach which uses ontologies in order to specify domain specific knowledge. This approach requires an already defined ontology, which may be defined in an ontology language like the web ontology language [21]. The in [19] implemented framework allows users to specify goals, which have to describe the data cleaning rules and which are then being transformed into an ontology language. These rules are then being executed.

VI. Future research

Domain specific data cleaning is a new research area, where a lot of work has to be done. One has to think about technologies which can be used to support these cleaning tasks. Ontologies may be a best-fit technique in order to model data sources and targets. When thinking about constraints, which have to be respected in data cleaning, one has to decide how these constraints have to be implemented when using an ontology-based approach. When thinking about available data cleaning methods, one has to think about how these can be integrated into a data cleaning architecture, which may be based on an ontology. One has to think about how to define an abstract, general architecture, which is not applied to a specific domain, like public health care, and which can then be specialized in respect to concrete domains.

CARAMEL has to be extended in order to fulfill all these data cleaning tasks and will be extended with domain specific cleaning methods. Metamodels which are able to describe the Cancer Registries database and data sources have to be created to support these domain specific cleaning tasks.

VII. CONCLUSION

This paper has introduced the application CARAMEL, which is being used in the German public health care in the Cancer Registry of Lower Saxony. Here it has been developed in order to integrate data, which is being delivered in many different data formats, which is being encoded using PGP in order to meet the security restrictions, defined by the Law about the Cancer Registry. Data cleaning has been introduced in section three, where we have introduced a new classification of data cleaning challenges, which describes data cleaning problems as syntactical, semantical or domain specific problems. After having introduced the specific needs the Cancer Registry has on data integration we introduced the architecture of CARAMEL and the necessity of building and using a plugin-architecture. Then several plugins have been introduced. Some are being used in order to read data files based on several formats and other allow a couple of data cleaning tasks. We have shown which solutions do exist within CARAMEL for which kind of problems and have defined the advanced ontology-based data cleaning challenges as important future tasks in data cleaning and in the development of CARAMEL.

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Systemic Thinking in Multi-agent Systems Coordination – Applied in Diabetic Health Care

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Abstract-Computer agent is considered as a technology that may support human beings with automatic functionalities in the social environment. This paper describes an approach to applying agents to diabetic health care. A good health care agent is considered to be able to keep a good balance between individual flexibility and team control. A systemic approach is proposed hereby as a complementation to the current approaches. Multi-agent Systems (MAS) coordination is considered on three levels: collaboration, coordination and communication. In the end, an agent-based computer system – Integrated Mobile Information Systems (IMIS) – is discussed based on the systemic approach.

I. INTRODUCTION

Diabetes is attracting more and more attentions of the researchers from both medical and technical fields. On the one hand, the various complications caused by diabetes require various specialized medical workers to be involved in a single case. On the other hand, new technologies are needed to aid the cooperation among different medical workers. Hereby computer agent is considered to be a good candidate of new technology in this need.

Having been developing for decades, Agent Technology is considered to be of great opportunities in various kinds of approaches. Agent simulation, for example, has been utilized in various areas to help reduce the cost of human decision making [1, 2].

When adopting agents into diabetic health care, several approaches may be taken. Two current dominating approaches are reductionism and constructionism. Each has its advantages and weakness. In the following sections, we will first discuss the above two approaches within the diabetic health care background. Then we will introduce our systemic approach. In the end, we will introduce our project Integrated Mobile Information Systems for diabetic health care (IMIS) – an agent-based system designed for the diabetic health care.

II. MULTI-AGENT SYSTEMS COORDINATION

Agent is considered to be a computer system that is capable of executing some tasks automatically without human beings' interfere. Computer agents work together towards an expected state of the environment. This cluster of agents forms a Multi-agent System (MAS). The interaction among agents is called coordination. MAS coordination mainly contains two trends, reductionism and constructionism.

P. Reductionism

Reductionism dominates in a sub-area of MAS called Cooperative Distributed Problem Solving (CDPS). CDPS usually takes a top-down solution to the problem solving. Starting with the top-hierarchy, the problem is decomposed into sub-problem, which continues to be decomposed until the sub-problems are able to be solved by individuals. The sub-hierarchy always obey the super-hierarchy. Thus, their interests should comply with the super-hierarchy's interests, which eventually lead to the top problem. The benevolence assumption is usually considered as a precondition in this area. The benevolence assumption states: the agents in a system implicitly share a common goal, and thus that there is no potential for conflict between them [3]. Benevolence assumption indicates that sacrifice is necessary for every agent when its individual goal is in conflict with the team motivation.

The strong point of reductionism is that it keeps a good tradition from scientific method. Reductionism leads to a good hierarchy in problem solving. In diabetic health care system, such kind of thinking is necessary. For example, a diabetic patient may need to keep in touch with various care providers, since often he or she suffers from more than one kind of complications. There may be many doctors and nurses involved in this case. With reductionism, we can build up a hierarchical MAS, within which the responsibilities of individual agents are specified clearly. The team interest is always considered with the highest priority. There is less possibilities of misunderstandings and mismatches among agents, because all sub-hierarchy agents must comply with their super-hierarchy agents.

However, in the reality, diabetic health care system is flexible in the sense that the patients are usually cared distributedly. The care providers (doctors, nurses) possess autonomy to some extent. And they must consider the

individual patient that they are taking care of as the most important objective. They cannot make a decision to sacrifice one of their patients to optimize the whole team's interest. Reductionism may optimize the team's interest, but it will lose the flexibility of agents.

Q. Constructionism

The constructionists, compared with the reductionists, concentrate on the individual agents. Individual agents are considered to be self-interested. Individual agent always takes the actions that will optimize their own interests. The team's (MAS) interests are achieved through the coordination among individual agents under some predefined protocol, e.g. auction. The MAS coordination based on constructionism often leads to competition.

The strongpoint of constructionism is that it gives many details to the agent design and implementation. Agent autonomy is realized through distributing control and resource to individual agents. Individual agents decide their actions, or even their goals. From this point, the MAS is flexible. Often there is a central monitoring unit playing a similar role as server, which monitors and coordinates the agents' activities.

However, decentralized control and resource may not always improve the MAS efficiency. The starting point of constructionism is the self-interest instinct of agents. Thus, it is a difficult issue to make agents cooperate in this case. A famous cooperation protocol is Contract Net (CNET), which is a high-level protocol for achieving efficient cooperation through task sharing in networks of communicating problem solvers [4-6]. In Contract Net, there is no permanent central unit. Every node/agent may become a centre for communication. When there is a task, the task generator becomes the centre/server who will coordinate the coordination among other agents. When the task is achieved, the relationship among the agents will be destroyed at the same time. Thus, the relationship among the agents is dynamic.

In diabetic health care, the relationships among stakeholders/agents are static and stable. The diabetic patients normally keep constant contact with their care providers. Thus, a centralized coordination mechanism may be more efficient than a decentralized one, since there is no need to set up relationship temporally at run time. Besides, in health care area, we cannot let the agents have full autonomy and do whatever they want. A group of self-interested agents may compete among each other and decrease the efficiency and quality of the diabetic health care. In summary, if we take the constructionism, we may give much flexibility to agents, but it is easily to lose the control over agents.

III. Systemic Approach To MAS Coordination

From the above discussion, neither reductionism nor constructionism is realistic in the diabetic health care. A good agent should keep a good balance between individual flexibility and team control. Thus, we believe that we need to find a new way of thinking about MAS coordination in application in diabetic health care.

In this paper, we give some systemic thinking to the MAS coordination. The aim is to find out a general mechanism for MAS coordination, which should give the agents autonomy as much as possible, while keep the general maintainability of MAS at the same time. The systemic thinking hereby indicates that MAS is considered as a holistic system during the analysis. The individual agent is considered as a system element, which has interrelationships with other agents.

Systemic approach, compared with reductionism, allow the system elements to keep autonomy to some extent. That is, the individual agent is considered as self-interested. However, different from constructionism, the individual agent is always part of the whole MAS.

A. Five Parameters to Define MAS

According to [7], there are five parameters that are necessary to define a MAS: 1) level of cooperation among agents, 2) regulations and protocols, 3) number of agents, 4) type of agents, and 5) communication and computation costs.

Computer agents can be designed to be cooperative that they work together to satisfy the same goal. In this case, there is only cooperation in MAS coordination. However, agents are often designed to be self-interested, who try to maximize their own utilities. The coordination among extreme self-interested agents is competition. There are also intermediary cases that self-interested agents coordinate themselves to achieve a joint goal.

Normally the designers of the agents should agree on some regulations for the agents to interact in advance. The regulations often depend on the environment where the agents will work in. The protocols are the languages that agents use to communicate with each other. There are also cases that there are no pre-defined regulations.

The number of agents is an important parameter for MAS. Depending on the size of the MAS, different approaches may be taken to design MAS coordination. For example, if the number of agents is small, game-theoretic and operation research (OR) techniques may be good candidates. If there are a large number of agents in the MAS, game-theoretical approaches may be too time-consuming and complex. A good candidate is the methods of classical mechanics used by physicists to tackle the problem of finding the properties of interaction among many particles [8, 9].

Agents may be classified to several categories depending on the extent to which it is autonomous. Agent can be simply purely reactive to the environment. Agent can also be intelligent to autonomously achieve the tasks without any interfere from human beings. Agent can also be a composition of computer systems and human beings. In this paper, we classify agents into three groups: collaboration/activity agent, coordination/action agent, and communication/operation agent.

Agents communicate and compute in order to achieve their tasks. It costs time and power. If the designers put most of the computation work load on a central server, the agents do not need to communicate a lot. However, the computation cost of the central server will be high. One the contrary, if the designers put the computation work on the individual agents, the computation cost of the server will be highly decreased,

but the communication cost between agents will be increased. Thus, the communication and computation cost should be determined based on the problem situation in the reality. A good balance between computation and communication should be found before the MAS designers decide the MAS architecture.

B. Three Levels of MAS Coordination

The systemic approach considers MAS coordination on three levels, communication, coordination, and collaboration [10]. When designing MAS coordination protocol/mechanism, these three levels should be considered.

Communication level is the basic level. On this level, agents are able to exchange message among each other. The realization of this level requires a common ontology among agents. Agent Communication Languages (ACL), for example, KIF [11], KQML [12], are enough to realize this level. Normally, ACL are message based language for agent communication.

Coordination level is where agents exchange goals, while communication level is where agents exchange information. The goals hereby mean the intentions owned by individual agents. Once an agent decides its goal, it should commit to it and should not give it up easily. Thus, it is very important for the individual agent to coordinate their goals to avoid the conflicts to the lowest level. A possible solution is to define the agents' goals carefully in advance. In a relatively static environment, e.g. diabetic health care, this can be done through specify agents' roles according to health care labour division.

On the collaboration level, agents should consider the motivation of the MAS activity. Motivation belongs to a group of agents who are performing one activity. All the individual agents in one activity work to achieve the same motivation. Thus, even though the individual agents have different goals, they still collaborate to achieve the same objective/motivation.

C. Systemic Approach to Design

To start designing the MAS coordination mechanism, systemic approach should give a definition to the target MAS according to the five parameters. Then, the collaboration level should be considered firstly. This is a general design of the MAS construction. Main activities are defined. Secondly, the coordination is designed in order to perform the activities. The relationship among agents are defined. Thirdly, the communication language is chosen for the agents to exchange message/information.

IV. Case: Integrated Mobile Information System (IMIS)

In this section, we will apply our systemic approach to design an agent-based computer system – IMIS. IMIS is designed to support the diabetic workers with agent-based services.

D. IMIS Definition

We consider IMIS as a MAS. We define this MAS according to the five parameters introduced above.

The cooperation among IMIS agents exists on three levels: collaboration, coordination and communication. On collaboration level, IMIS agents focus on the cooperation among health care organization. On the coordination level, IMIS agents are considered to be self-interested. The reason that we design IMIS agents to be self-interested instead of cooperative is that we want to give as much as possible autonomy to the agents. Cooperative agents can work smoothly with each other. But this will loose the point of autonomy, which is necessary in diabetic health care.

The regulations of IMIS agents are mostly based on the practical situation of diabetic health care system. Nowadays, the Swedish health care involves various formal and informal organizations. Hospital, Municipality and County Council are formally involved in the health care with their corresponding health care services. There are also some informal organizations involved, e.g. shopping, taxi, etc. IMIS cannot change anything about the regulation in these organizations. What we can do is to apply and reflect the existing regulations to the MAS coordination design.

IMIS will start from a small area for testing purpose. However, during the process of development and application, a broader area will be applied. A systemic approach is taken to consider IMIS design. Three levels or steps in this approach will be discussed later.

IMIS is an Internet-based system. The IMIS agents are considered as Information Agent [13]. In diabetic health care analysis, we consider the whole system on three levels: activity/collaboration, action/coordination and operation/communication. Correspondingly, we classify IMIS agents into three groups: collaboration agent, coordination agent and communication agent. The communication might use the ACL, e.g. KIF, KQML, or standard information exchanging language on Internet, e.g. XML.

An important aspect of diabetic health care is the distribution [14]. The IMIS agents work at the edges of the system. Thus, we put most of the computation work load on the distributed individual agents. The work load of the IMIS server is decreased to the most extent. The computation is thus distributed.

E. IMIS Coordination Mechanism

Based on the above definition, IMIS coordination design is considered on three levels: collaboration, coordination and communication. The IMIS agents are classified by their roles in the coordination.

The collaboration level of IMIS is also the most intelligent level where agents can serve. IMIS collaboration is conducted by collaboration agents. The main task of collaboration agents is to collaborate health care organizations. In IMIS we define several organizations like hospital, home services, patient homes, and other services providers (shopping etc.). These health care organizations conduct their corresponding health care activities. The responsible agent for each activity is called collaboration agent. Collaboration agent defines the role/activity and the responsibility of each organization. Another important task that the collaboration agents conduct is to decompose the activities into actions and delegate them to the sub-level agents, which are considered as coordination

agent. As Figure 1 illustrates, collaboration agents are responsible for the health care organizations, e.g. hospital, home service, other services providers and patient homes. These agents coordination through the IMIS server.

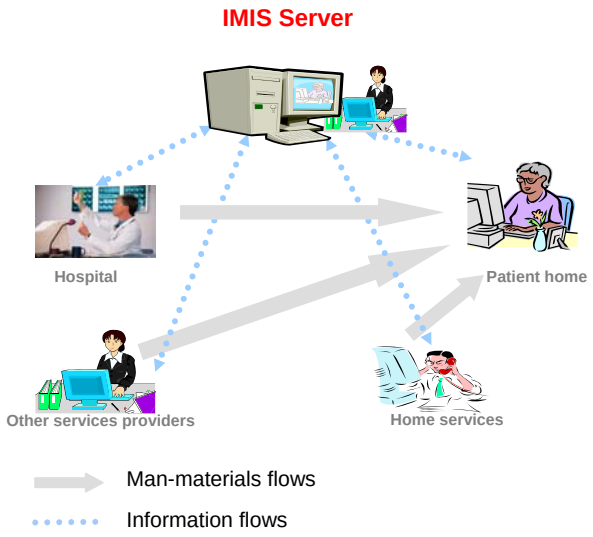

Figure 1. IMIS collaboration

The coordination level of IMIS is responsible by coordination agents. From the collaboration agents, health care activities are decomposed into smaller tasks/actions that can be performed by coordination agents. Coordination agents mainly conduct two kinds of actions, depending on whether the two coordination agents are within one health care organization or not. For example, in Figure 2, agent 2 and 3 both work in home care organization from County Council. They may be involved in one health care activity – taking care of one patient. Thus, to achieve this task they need to coordinate their work. In another case, agent 3 and 4 work for different organizations. Agent 4 works for Home Service from Municipality. They also may work in the same health care activity. In this case, cross boundary coordination is needed. The latter coordination is the most important role that the coordination agent should play in the reality. There exist many misunderstanding, mismatches between different health care organizations. These misunderstanding and mismatches are considered as 'Grey Zone' in our IMIS. Thus, the most important task of IMIS coordination agents is to work within the Grey Zone and make a good connection between different organizations. We have described the Grey Zone problems in [15].

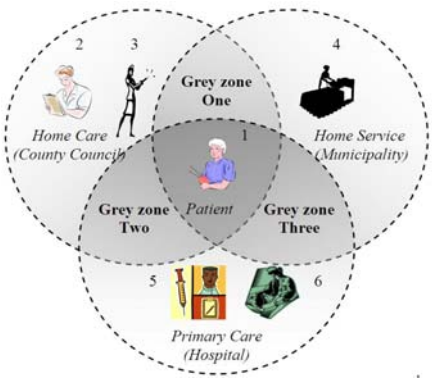

Figure 2. IMIS Coordination

The communication level on IMIS platform is the technical level. Nowadays, the nurses use mobile as the main tool for communication with each other. Some other tools like fax, email, SMS are also used. These different communication channels are not guaranteed to be working in a synchronizing way. IMIS platform is itself a common communication platform. Care providers and care receivers can share their information on this common platform. This avoids the mismatch and desynchronization problem that might caused with the mobile communication. With information sharing, the IMIS agents can work on either stationary computer or mobile devices. The care providers can visit the IMIS system at anytime anywhere to access the most updated information of the patients, and upload the new information of the patients to let other care providers to browse.

Figure 3. IMIS Communication

V. CONCLUSION

We define IMIS to be a MAS that is: 1) made of self-interested agents, 2) regulated by difference organizations, 3) expanding size, 4) made up of Information Agent and 5) distributed computation. The IMIS coordination is realized by on three levels via three categories of agents. The whole IMIS system is considered as a MAS. The IMIS coordination is classified into three levels, on which corresponding agents are taking the responsibilities. See Table 1.

TABLE I
Summary of IMS coordination levels

MAS Coordination levels	Collaboration	Coordination	Communication
Agent type	Activity agent	Action agent	Operation agent
Objectives	Collaborate big health care organizations. Decompose activities and delegate to action agent	Coordinate agents within one activity. Decompose actions and delegate to operation agents	Smallest unit of IMS. Communicate with each other on technical level based on standard protocols.
Example	Task delegation	Organization coordination	Information sharing

Compared with reductionism, systemic approach gives much more autonomy to the individual agents. In

reductionism, individual agents are considered as sub-unit that must obey their super-hierarchies. On the coordination level, individual agents are allowed to possess individual goals or intentions. Thus, the agents can make their own decisions and try to maximize their own utilities. This gives much freedom to the agents.

Compared with constructionism, systemic approach starts with the whole MAS. It gives a holistic view on the MAS coordination via the collaboration design. MAS activities are designed in the first stage. Based on the MAS activities, individual agents are assigned with actions, which compose of activities. Although, individual agents have the autonomy to take any actions, the actions cannot be inconsistency with the MAS activity.

In summary, through a balance between MAS collaboration and agent coordination, a balance between team control and individual autonomy is realized.

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User Experience Design Guidelines for Telecare Services

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I. INTRODUCTION

The present paper introduces the user experience and usability aspects of telecare services, related challenges and recommended design guidelines applicable to a wide range of telecare solution elements, addressing key characteristics and the interactions between them and the primary (client) and secondary (carer) users, under development in ETSI, co-funded by the European Commission and EFTA.

Telecare is a strategic enabler for the provision of independent living to older people in their own homes in Europe, driven by demographics and new technologies.

The number of elderly people and people with special needs is growing rapidly, requiring dedicated supportive efforts for those unable to cope with every day's technology. For the elderly population, access to Telecare services is important but often difficult due to their lack of familiarity with ICT.

With the technical development offering seamless and more continuous access to fixed and mobile broadband networks, the vision of a world where ICT resources around us improve the quality of our lives becomes realistic. New applications and services can increasingly be used to perform necessary tasks and activities of daily living.

The changing demographics of Europe indicate a development towards a population getting older and living longer than ever before. The aging of our society has unveiled the problem of dependency, as the number of dependant citizens is increasing, especially at the higher levels of the population pyramid. The majority of the dependant population receives informal care, but the population of informal carers is decreasing and aging. These facts may be causing the decrease of the family support to elderly people and people with disabilities and therefore demanding new paradigms to provide support to dependency and independent living.

According to the United Nations Developing Programme, better health care services are required on a global level, but its costs and expenses are not allowed to continuously increase (without a collapse of the system in the aging Western world). It is estimated that in 2051, 40 % of the European population will be 65 yeas or older.

Responding to demands for better healthcare raised by an aging population can increase the cost pressure at a time when health care spending is already on the increase. In 1970, the healthcare-related spending of the Organization for Economic Co-operation and Development (OECD - www.oecd.org) countries averaged 5 % of GDP. This increased to 7 % in 1990 and is more than 8 % at present. In addition, it exceeds 10 % in Germany, Sweden, Switzerland and the United States [1].

More than 75 % of all OECD health spending is publicly financed. Based on assessment of countries' experiences, analysis of underlying issues and review of evidence and in order to control the increasing pressure, OECD recommends actions including the introduction of automated health-data systems, strategies making use of new technologies and improved quality of care through better information.

The European Commission encourages EU Member States to seek a balanced status among the detected needs of providing quality care and social services to citizens, being compliant to standards, containing costs at a national level, and managing services at a local level. "*e*-Health is today's tool for substantial productivity gains, while providing tomorrow's instrument for a restructured, citizen-centred health system and, at the same time, respecting the diversity

of Europe's multi-cultural, multi-lingual health care traditions". A key ambition is better care services at the same or a lower cost.

The maintained delivery of traditional health care services to these user groups would lead to a considerably increased cost at a questionable perceived quality, as these clients expect freedom of choice, mobility and personal attention on demand, see ETSI TR 102 415 [1]. In addition, as mobile and broadband communication technologies mature and the average user knowledge level is considerably increased, these clients have an already established experience and trust in the use of more sophisticated ICT products and services.

Human factors and the user experience related to the delivery of health and social care to individuals within the home or a wider community, with the support of systems enabled by ICT is a complex area. It involves a large number of influencing elements, including the establishment of human confidence, device setup, configuration, calibration and maintenance, data collection, user procedures, cultural issues such as the use of language and illustrations, the organization of the care provisioning process, and communication with diagnostic systems and carers, human communication and confirmation and decision making, the presentation medium and accessibility issues.

In addition, as telecare services can be used not only in, but also outside of homes, usability aspects relating to the specifics of mobile environments and equipment and service use need to be covered. Last but not least, these services must be used by young, older, impaired and disabled people [2-3] and therefore, designed accordingly!

II. TELECARE- PAST, PRESENT AND OUTLOOKS

Telecare should clearly be distinguished from *telemedicine*, customarily defined as the use of ICT to support cooperative work between health professionals, a business-to-business service.

In accordance with TR 102 415 [1], the following definition applies:

"Telecare is the provision of health and social care services to individuals, within or outside of their homes, with the support of systems enabled by ICT".

The main aim of telecare is to reduce the need for hospitalization and institutionalization and refers to cases where services are provided to an end user, it can thus be classified as a kind of business-to-consumer service.

Telecare services include health-and social care related information provided through the telephone or the Web, automated appointment reminders, client monitoring services at home or on the move, the identification of emergency situations, et cetera.

In a historical perspective, medical treatment, cure and care until the mid-1900s used to be provided by trained (or at least, experienced) physicians in the client's home; family and neighbors often acted as nursing and supportive staff.
During the development of modern life of the 20th century, this healthcare model has changed quickly and dramatically. Medical care is nowadays most often care unit-centric, often requiring access to advanced medical equipment. A General Practitioner or specialist Medical Doctor's visit to the client's home has become an unusual service.

As a measure to overcome distances, telemedicine was introduced in the 1960s as isolated, stand alone efforts. The first community alarm services were introduced at the University Of Nebraska College Of Medicine in 1959. This was soon to be followed by telephone- or videoconference-based televisit services, as documented in.
Social care services have been supported and extended by Information and Communication Technologies (ICT) during the last 10 to 15 years (through e.g. call centre based services, home equipment for social alarms, etc.). The underlying technology, as well as the availability of these services, did not change much during the last decades.

The widespread deployment of telecare services was held back by factors such as the:

- Lack of efficient and reliable telecommunication networks and devices with the necessary capabilities;
- Unavailability of hardware and software at reasonable costs;
- Lack of on-line connectivity;
- Relatively stable demographics;
- Lack of political conviction, initiatives and support;
- Lack of client trust, acceptability and client expectations and habits;
- Resistance from healthcare professionals (social patterns take generations to change);
- Lack of proven outcome benefits.

Users were not ready yet, nor were the prerequisites- technology, society, technical infrastructure, practitioners, procedures, budgets, et cetera- available and established for a successful deployment.

The proliferation of fixed and mobile broadband services in and outside the home is opening up opportunities for the delivery of telecare services. Thereby, the demand for end user (client) centric human factors guidelines addressing

design, development, deployment, use and maintenance of telecare services is on the increase.

In the 1990s, digital technology enablers (infrastructures, terminals and services) became available to the mass market. At present, demographic changes, limited resources, high user expectations, globalization and technology are transforming medical and social care systems in many countries. The penetration of ever-smarter devices connecting to mobile communication networks and the World Wide Web through fixed and mobile Internet, combined with society-oriented, Europe-wide initiatives, health and social care service providers' support, evidence of the existence of demographic and economical feasibility enablers, accepted changes in the delivery of health and social care services and the progress achieved in the area of medical technologies, pharmaceuticals and disposable products enable the deployment of telecare services.

III. A EUROPEAN E-HEALTH AREA UNDER CONSTRUCTION

The European Commission's *e*Europe action plan [1] has recognized that the potential of the Information Society (IS) "…is growing due to the technological developments of broadband and multi-platform access". Furthermore, *e*-Health has been identified as one of the priority objectives of the *e*Europe 2005 Action Plan.

The milestones required to build a "European *e*-Health area" have been defined on four levels; these are:

1. *Basic level*: by mid-2004, a European Health Identity Card (EHIC) shall be introduced (already achieved);

2. *National level*: by 2005, EU member states are required to develop national and regional *e*-Health strategies;

3. *Interoperability level*: by 2006, national healthcare networks should be well advanced in their efforts to exchange information, including client identifiers;

4. *Networked level*: by 2008, health information and services such as *e*-prescription, *e*-referral, Tele-monitoring and Telecare, are to become commonplace, accessible over both fixed and mobile broadband networks.

IV. OUR APPROACH

Our approach to telecare services builds on the framework described in [1], whereby personal monitoring, security management, electronic assistive technologies and information services are used to support personal health and well-being.

Telecare is generally associated with care of older people, however it has been shown that it is applicable irrespective of age. In addition telecare may empower people with sensory, physical, cognitive or other impairment(s), temporary or permanent. Telecare solutions must embrace the philosophy of design-for-all, promoting accessibility by as large proportion of end users as possible. Complementary solutions based on assistive technology must be available, when required.

Human factors and the user experience of telecare services involve the consideration of many factors, including user confidence, device setup, configuration, calibration and maintenance, data collection, user procedures, cultural issues such as the use of language and illustrations, the organization of the care provisioning process, and communication with diagnostic systems and carers, human communication and confirmation and decision making, the presentation medium and accessibility issues.

In addition, as telecare services can be used not only in but also outside of the home, usability aspects relating to the specifics of mobile environments and equipment and service use need to be covered. Last but not least, these services must be usable to young, older people, impaired, disabled or temporarily ill people.

By means of user experience, telecare services can gain considerable benefits from applying human factors expertise. We foresee that our work can have a major impact on several important stakeholders and areas:

- For **clients***:* understandable and usable set-up procedures and user guides for telecare terminals and services, resulting in increased user satisfaction and inclusion of all users including those with special needs; improving their confidence in the use of telecare services, and thereby supporting their independent living style.

- For **carers**: improving efficiency and satisfaction of both formal and informal carers, when using telecare services.

- For **health and social care providers**: providing them with guidelines for taking users' views into account, and therefore improving their efficiency when adopting new Telecare procedures.

- For **manufacturers, designers and developers**: references to generate products and services which are closer to the needs, abilities and preferences of users, thereby reducing unnecessary risks and experimentation inherent in the lifecycle of a product or service.
- For **public administrations**: support on decision taking during public procurement processes.

- For **governments and policy makers**: support the expansion of Telecare services.

Medical devices have traditionally been designed for use by professionals, in hospital environments, and coming with an extensive training programme. With telecare, medical devices may require handling by the clients themselves, who are non-professionals, often with little or no training in using complex electronic devices. This requires a change in the mindset of the designers of medical equipment, so that a default workable configuration, fail-safe operating procedures, compatibility with other electronic equipment in use and set up and self-documenting without requiring manuals become a default part of the process.

There are opportunities to create additional benefits for clients, by integrating home safety monitoring and control with both health and social care oriented telecare services. For maximum usability of telecare services by the general population, more effort should be put into the design of hardware and user interfaces, with close attention paid to the opportunities of creating a single user interface, applying generic UI elements to control multiple applications and services for the client, carer or coordinator. Services must be designed to be fail-safe, not promote excessive dependency and be controllable remotely by carers or coordinators, when appropriate.

V. STAKEHOLDER'S DIMENSIONS, GUIDELINE AREAS AND THE STRUCTURE OF THE GUIDELINES

The user experience ETSI Guidelines under development will address four categories of end users:

1. Patient users (clients);
2. Care service providers;
3. Buyers and procurement responsibles; and
4. Developers and (infrastructural) access providers.

There exist three main categories or dimensions of aspects to consider when approaching user experience of telecare services- these are covered through:

1. Telecare service life-cycle stages, through the structure of the clauses providing:
    a. research and specification, design &development, testing, manufacturing, service deployment, setup & configuration, service provisioning and initial use, service maintenance and replacement guidelines; and
    b. additional usability, accessibility, mobility, interoperability and personalization guidelines.

2. Stakeholders, covered by the structure of the guidelines; and

3. Human factor characteristics, addressed through the content of the guidelines.

Due to the complexity of telecare services and the numerous solution elements involved in the design, delivery, setup, configuration, use and maintenance of telecare services, the human factors and usability of telecare services must cover such aspects as the ergonomics of physical devices, compatibility and complexity of equipment and services, user interface aspects, set-up and configuration , user education and training, price and cost transparency aspects, communication terminals, network access and applications.

One of the most important goal of human factors, usability and accessibility activities in telecare is anticipate use cases and provide design solutions to eliminate errors that could cause harm to the client or to the carer. In order to be able to achieve this goal under the various constraints and user requirements, user centred design and development approaches play a very important role. Telecare services should not be technology driven but user centric.

VI. ETHICAL, PRIVACY AND SECURITY ASPECTS OF TELECARE SERVICES

In order to illustrate the width and complexity of the user experience of telecare services, let us examine the related ethical, privacy and security aspects.

The use of information technologies in the home raises ethical questions concerning privacy, security, freedom of choice, dependency and consent, particularly important in the development of systems for people who are not able to control the technology themselves - for example, people with dementia or other mental impairments.

Several strategies could improve the ethical and non intrusiveness aspects of telecare services. Recommendations and guidelines are under consideration for:

- Respect of the privacy of users;
- Minimize intrusion when introducing telecare services and during the collection and use phases of client data (personal or gathered from monitoring systems);
- Avoid the use of technical language, as this may interfere with the understanding of telecare services;
- Take into account the role of relatives, friends and people providing informal care, and its implications in Telecare service provisioning;
- Reduce the impact of the equipment in homes, by adapting the design, behaviour and other characteristics of relevance to the home environment;
- Present telecare services and systems as tools of self-empowerment, rather than as an outward sign of dependency on external services and aids;
- Telecare services should be promoted in ways affirming positive views of the service;
- Regarding the independent living style for disabled people, feasibility of telecare services should always

be offered as a complement or alternative to healthcare services delivered by human beings; and

- Ethical codes of care professionals should be made applicable to all Telecare services.

Privacy is not just about hiding information or confidentiality but also about control, autonomy and integrity. It is the right of people to control what personal information should stay inside their own house and what can be distributed to the outside world. It is as well the right to control for which purpose personal information should be collected, maintained and used. Providers of telecare services need to make sure that the user right to privacy will not be lost and that technology advancement can be developed alongside privacy interests.

As a baseline, it could be expected that people's negative attitudes to privacy will reduce as the benefits and inevitability of living with pervasive sensing and computing technologies becomes more apparent. However, whilst the benefits of some aspects of telecare are compelling and immediate (e.g. the monitoring of cardiac arrest amongst high-risk patients), the benefits of "mass-market" (mostly preventive) telecare services are far less tangible or immediate. It is the growth of the latter applications that is in greatest danger of being severely restricted by privacy concerns.

Although telecare solutions in the European Union will need to conform to relevant European and national regulations and laws (governing, for example, data protection), it seems unlikely that these alone will be sufficient to allay the privacy concerns of most users. For telecare solutions to become truly acceptable to a larger number of people, technology and service providers have to develop products that consider both security and privacy practices. The risks should be assessed and appropriate security measures and well-known practices should be defined to maintain the risks under an acceptable level. The aim is to increase the client involvement and allow the client to have more interaction with and control over the information about his status and behavior with the final goal to improve the overall trust on the system.

In [1], the following recommendations are made:

- The client should be given clear notice of the presence of telecare technology in their environment;
- The client should be given the opportunity to engage and interact with their personal information and to understand the benefits of telecare technology;
- There should not be any prohibition on clients to control their personal information;
- The telecare system should provide to the client a clear and complete access to the personal information collected;
- Telecare technology should not be deployed to monitor and identify people that are not directly associated with a telecare service;
- Telecare services must not be exploited in any case for marketing purposes, or to collect or derive personal information about consumer product habits;
- Information must be collected and distributed in a secure way;
- Measures should be put in place to ensure compliance to the regulations. The client should be able to complain where its privacy has been violated.

Two distinct challenges are identified in terms of privacy and security:

- It is necessary to ensure that a client is monitored with the correct security requirements, and also that the data collected cannot be eavesdropped or accessed without authorization.
- Personal information must be securely shared among multiple carers, public health services and private enterprises. Privacy concerns about information flows across multiple domain of ownership or control can stop stakeholders in participating in data sharing. Users will be concerned about the likelihood of that party keeping the information very secure, and to only use the information for its intended purpose.

There are three non-exclusive strategies to follow, addressing telecare service user's privacy concerns:

- Keep the information as local as possible;
- Give control to the user; and
- Promote industry privacy standards.

In addition, it is recommended to consider defining the information required, not only to the understanding and control of personal information, but also to the operators who must fulfill such roles in collaboration with different entities. As a simple example, it would probably be beneficial to standardize the information sent to various emergency services in the event that the system detects an emergency.

Central to several of the above recommendations are the high-level issues of enabling users to have simple and comprehensive control over the privacy of their personal information and ensuring that their personal information is only shared with the correct people/organizations.

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Mobile Phone Videoconferencing as a Tool for Rapid First Look Diagnosis

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Introduction:

Physicians involved in treatment of injured patients require fast access to medical images. There are still some hospitals without integrated informatics network, but located within area covered with 3G network. Nowadays diagnostic equipment used for diagnosis of politrauma patients generates large number of images. Dramatic increase of image number was observed at the time of introduction of multislice CT scanners. One examination can contain several hundreds of images. The facility is located in several separated with no unified HIS-RIS network. The purpose of the study was to test video calls possibilities in management of multiply injured patients to speed up diagnosis during services.

Method:

We performed video conference calls total time 240 min, using mobile phones Sony Ericsson K600i for verbal communication and image transfer between consultant radiologist and trauma surgeons. CT scans were captured from CT workstation equipped with LCD displays immediately after CT examination with 1.3 megapixel camera mounted inside the mobile phone and transferred to the recipient. Mobile phones that were used in this project were equipped in a relatively small LCD display width - 176 x height - 220 pixels.

Results:

We have observed no telecommunication problems during video calls. Small objects were seen more clearly (e.g. single CT scans) in comparison to conventional, normal size X rays. We found especially difficulties of assessing pictures with high contrast between elements resulting in blurring of the object edges and averaging of neighboring structures that were displayed in form of large rectangles in various shades of gray.

Conclusion:

Video calls utilizing mobile phones equipped with cameras for video conferencing can be used as an efficient tool facilitating rapid diagnosis in politrauma patients. The first look on medical images via video call may fasten introduction of some surgical procedures. The positive impact on image quality transmitted via video call should be expected with modern technology introducing 2 and more Mpixels cameras and optimally bigger screen in phoning device like in PDAs.

Key words: Video call, teleconsultation, trauma patient

Session 6

Community eHealth and Disease Surveillance

Extracting, Storing and Viewing the Data from Dicom Files

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Abstract-This article presents a Java based software tool that implements a series of algorithms in order to extract alphanumeric information and image(s) from the DICOM standard files. The extracted data are stored in a database with a specific structure and can be visualized and subjected to some processing. The structure of the database also facilitates a flexible process of text-based query on any of the tags presented in the Data Dictionary. The created software tool incorporates a Dicom viewer, a database and a search engine. It was created to satisfy the present and future requirements of the Romanian specialists. It represents the first step in building a database for patients at the level of the hospital in the beginning, with the prospect of being extended to the county and even national level.

I. INTRODUCTION

DICOM - (From Digital Imaging and COmmunications in Medicine) is a standard developed by ACR (American College of Radiology) and NEMA (National Electrical Manufacturer's Association) for communications between medical imaging devices [1]. It is conform to the ISO reference model for network communications and incorporates object-oriented design concepts. The standard specifies: a set of protocols for devices communicating over a network; the syntax and semantics of commands and associated information that can be exchanged using these protocols; a set of media storage services and devices claiming conformance to the standard; a file format and a medical directory structure to facilitate access to the images and related information stored on media that share information [1], [2], [3], [4]. Such connectivity is important to cost-effectiveness in health care. DICOM users can provide radiology services within facilities and across geographic regions, gain maximum benefit from existing resources, and keep costs down through compatibility of new equipment and systems. For example, workstations, CT scanners, MR imagers, film digitizers, shared archives, laser printers, host computers and mainframes made by multiple vendors and located at one site or many sites can "talk to one another" by means of DICOM across an "open-system" network. As a result, medical images can be captured and communicated more quickly, physicians can make diagnoses sooner, and treatment decisions can be made sooner [1], [2], [3], [4].

The Dicom files contain both alphanumeric information (the name of the patient, date of birth, diagnosis, the name of the doctor) and one or more images compressed or in raw format. These files cannot be viewed on a computer. In order to do that, the Dicom files must be processed, the information must be extracted and eventually stored in a database. So, the information can be viewed anytime, subjected to some processing or queries. This processing mainly refer to operations that may lead to the improvement of the image quality and clarity, rotations that allow viewing from several angles, providing help for the medical personnel.

Creating a database by extracting the information and the images from the DICOM files, with the possibility to visualize all the data and to interrogate, brings high benefits to the electronic recording process of the patients. In this way, it is possible to find all the records relevant to a patient, which means all the investigations that have been made along the years using a medical device, which has DICOM, standard. Also, a database allows making statistical situations used on national or international level.

II. THE ORGANIZATION OF THE DICOM FILES

A DICOM file has the following structure [1], [2], [3], [4]:

- A preamble of 128 bytes
- Prefix (4 bytes) where are stored the letters 'D', 'I', 'C', 'M' which represent the signature of the DICOM file
- Data Set, which stores a set of information such as: patient name, type of image, size of the image, etc.
- Pixels that compose the image (s) included into the DICOM file.

Data Set is composed of a number of Data Elements. The Data Set represents a single SOP Instance related to a single SOP Class (and corresponding IOD).

A Data Set represents an instance of a real world information object and the Data Elements contain the encoded values of attributes of that object.

An IOD (Information Object Definition) is a model of abstract and object-oriented data, which allow specifying information about objects from the real world.

A Data Element is composed of several fields:

1. **Data Element Tag** – which identifies the information in a unique way. The Tag is also composed by Group Number (2 bytes) and Element Number (2 bytes). For example, in (0010,0020) tag the Group Number is 0010 and the Element Number is 0020. It is important the group with the number 0002 and the element with the number 0010 from this group which represent the Transfer Syntax Unique Identifier. The Transfer Syntax UID defines the byte order for raw data. The integer values can be stored using the big endian or the little endian ordering.

Little Endian byte ordering is defined as follows: in a binary number consisting of multiple bytes (e.g. a 32-bit unsigned integer value, the Group Number, the Element Number, etc.), the least significant byte is encoded first; with the remaining bytes encoded in increasing order of significance. In a character string consisting of multiple 8-bit single byte codes, the characters will be encoded in the order of occurrence in the string (left to right).

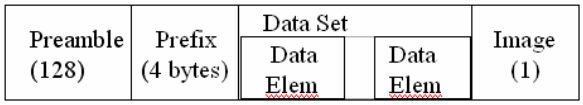

Figure 1. DICOM file structure

Big Endian byte ordering differs from the little Endian byte ordering by the fact that the most significant byte is encoded first. In Data Set, Data Elements are arranged in an increasing order of Tag Number and they appear only once.

2. **Value Representation** describes the type of data and the size for the value contained in Data Element. It is an array of chars stored in 2 bytes. VR for a data Element tag is defined in Data Dictionary, and the array of chars is encrypted using the default array of chars defined in DICOM standard. Some of the available value representations are: PN (Person name), TM (Time), AS (Age String), DA (Date). The VR may or may not be explicitly encoded in the data set. When it is used the Explicit VR function, Data Element is composed by four consecutive fields: Data Element Tag, VR, Value Length and Value.

An example of a Data Element with an Explicit VR, such as would be the case for data type OB, OW, SQ, or UN is shown in figure 2.

An example of a Data Element with an Explicit VR, such as would be the case for data types other than OB, OW, SQ, or UN is shown in figure 3.

When using the Implicit VR structure (figure 4) the Data Element shall be constructed of three consecutive fields: Data Element Tag, Value Length, and Value. If the Value Field has an Explicit Length then the Value Length Field shall contain a value equal to the length of the Value Field. Otherwise, the Value Field has an Undefined Length and a Sequence Delimitation Item marks the end of the Value Field.

3. **Value Length**: Either a 16 or 32-bit (dependent on VR and whether VR is explicit or implicit) unsigned integer containing the Explicit Length of the Value Field as the number of bytes (even) that make up the Value. It does not include the length of the Data Element Tag, Value Representation, and Value Length Fields, or a 32-bit Length Field set to Undefined Length (FFFFFFFFH).

4. **Value Field**: An even number of bytes containing the Value(s) of the Data Element. The data type of Value(s) stored in this field is specified by the Data Element's VR.

Group Number	Element Number	Value Representation	Reserved	Value Length	Value Field
2 bytes	2 bytes	2 bytes	2 bytes = 0x00, 0x00	4 bytes	"Value Length" bytes

Fig. 2. Data Element with an Explicit VR

Group Number	Element Number	Value Representation	Value Length	Value Field
2 bytes	2 bytes	2 bytes	2 bytes	"Value Length" bytes

Fig. 3. Data Element with an Explicit VR

Group Number	Element Number	Value Length	Value Field
2 bytes	2 bytes	4 bytes	"Value Length" bytes

Fig. 4. Data Element with an Implicit VR

5. **The Value Multiplicity** specifies how many values with this VR can be placed in the Value Field.

III. EXTRACTING THE DATA FROM THE DICOM FILE

Taking into account every tag from the DICOM dictionary can make extracting the data from the DICOM file. This will be searched in the file and in case of finding it the corresponding value will be extracted.

The steps of extracting information from DICOM files are:

1. Verifying the existence 'D','I','C','M' characters of 128, 129, 130 and 131 bytes of the file.
2. Establishing the type of VR (ExplicitVR or ImplicitVR). This information is given by the UID (Unique Identifier), information stored in value field corresponding to the Transfer Syntax Tag.
3. Establishing the Byte Ordering (BigEndian or LittleEndian). The information is also given by UID, stored in value field of the same Transfer Syntax Tag. The DICOM standard contains all the values that UID can have.
4. Searching a tag in DICOM file according to the VR type and ByteOrdering
5. Value extraction of the corresponding found tag.

DICOM Standard contains over 20 types of binary data or ASCII. The type of information stored in the value field is given by VR. In accordance with this type will be extracted strings, integer or byte type information.

Next it is described the problem of image extracting from the standard DICOM files, taking into account the method of compression that was used: RLE, JPEG.

The images from DICOM files can be classified using several criteria:

1. The number of images stored in a file: single frame or multiframe.
2. Number of bits per pixel: 8 bits, 12 bits, 16 bits or 24 bits.
3. Compression: without compression (raw) or with compression (RLE or JPEG).
4. Photometric interpretation: gray scale images, color images, palette color images.

In the images without compression, the extraction of pictures is made pixel-by-pixel, taking into account the number of bits stored for each pixel and the photometric interpretation (for monochrome images a pixel is stored using maximum 2 bytes and for color images, a pixel is stored using 3 bytes). In the images that use compression it is necessary a decompression algorithm before saving.

The pseudo code for retrieving the frames is:

```
Set variable number to 0
Loop until all frames are retrieved
  Set file dimension as Rows*Columns* (SamplePerPixel)
  Read all file dimension pixels from file starting with (Header Length + number* file dimension)
      If MONOCHROME image
          Save as image
      Store image using GIF or JPEG image format
          Return
      End If
      If PALETTE COLOR image
  Get the Palette tables (one for red values, one for green values and one for blue values)
          Get Pixels color from the Palette.
      Save as image
  Store image using GIF or JPEG image format
  End If
    If RGB image (24 bits)
      Get red, green and blue values
      Compute the color using the formula:
          ((255<<24) | ((0xff&r) << 16) |
          ((0xff&g)<< 8) | (0xff&b))
      Save as image
  Store image using GIF or JPEG image format
      End If
  End Loop
```

IV. STORING THE DATA FROM THE DICOM FILES

It is proposed a structure of the database different from the one existing in the DICOM standard. This structure has the advantage of permitting a flexible text-based query of the database using the table, which memorizes the entries from the data dictionary, specified by the DICOM standard. This table is also used to extract the information from the DICOM files.

Entity-relationship model [6] for the proposed database appears in figure 5.

The resulting tables are the following [6], [7]:

Tags table contains the following information:

- Tag – all the tags from Dicom Dictionary. For example: (0010,0010)
- The name of each tag. For example: Patient Name
- The Value Representation of each tag
- The Value Multiplicity of each tag
- The Version
- The Category of each tag. For example the information about the patient goes into Patient Category

Dicom_Files table contains:

- the unique identifier of the file
- the path to that file.

Images table contains:

- The unique identifier of each image stored
- The unique identifier of the Dicom file from where the image was extracted
- The number of the frame (in case of Dicom file with multiple frames)
- The path and the name of the image

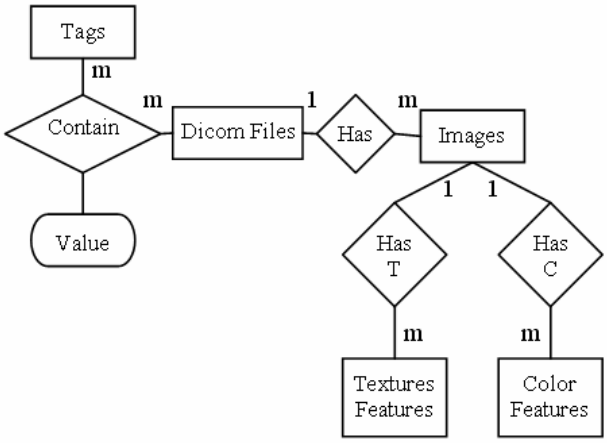

Fig. 5 The Entity-Relationship Model of the database

Header table contains the values of the tags retrieved from Dicom files:

- The unique identifier of each entry in the table
- The unique identifier of the Dicom file from where header information was retrieved
- The tag
- The extracted value.

The Header table appears as a result of a m:m relationship between the tables Tags and Dicom_Files.

V. DICOM VIEWER

The DICOM Viewer in the software system has the following facilities:

1. A tree view of all the DICOM files from the database sorted by their modality (CT, MR, US, etc)
2. An image view panel
3. A tools panel, which contains several image processing functions: (invert, blur, brighten and sharper functions, pseudo colors, edge detection)
4. Slider used to see a particular frame from multi frame images
5. Cine Mode for viewing a multi frame file as a motion picture

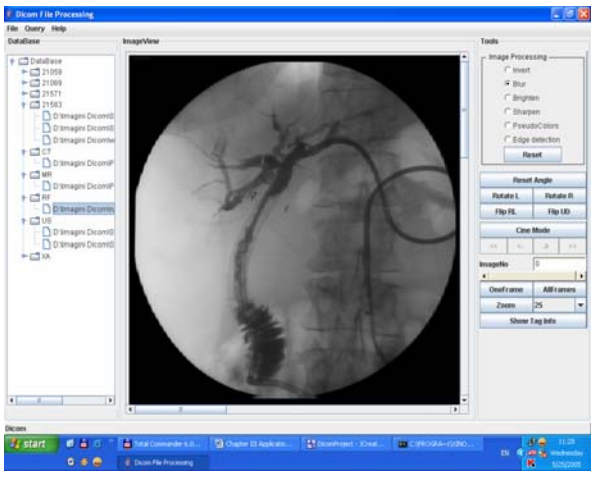

Fig. 6. The DICOM Viewer

6. A DICOM Tag Browser organized in categories for displaying all the tags from each category found in the DICOM file together with all their information and value.

The brighten function [5] with a general form brighten (beta) increases or decreases the color intensities in a color map. The modified color map is brighter if 0 < beta < 1 and darker if -1 < beta < 0.

It replaces the current color map with a brighter or darker color map of essentially the same colors.

The human vision system can only distinguish about 30 shades of grey in a monochrome image, but it can distinguish hundreds of different colors shades. Pseudo-coloring is a technique to artificially assign colors to a grey scale [5].

There are various approaches for assigning color to grey-level images. A technique, known as intensity slicing, assigns a shade of color to all grey levels that falls under a specified value and a different shade of color to those grey levels that exceed the specified value. The majority of the techniques perform a grey level to color transformations. The idea is to perform 3 transformations on a particular grey level and feed this to the three-color inputs (RGB) of a color monitor. The result is a composite image whose color content depends on the grey level to color transformations.

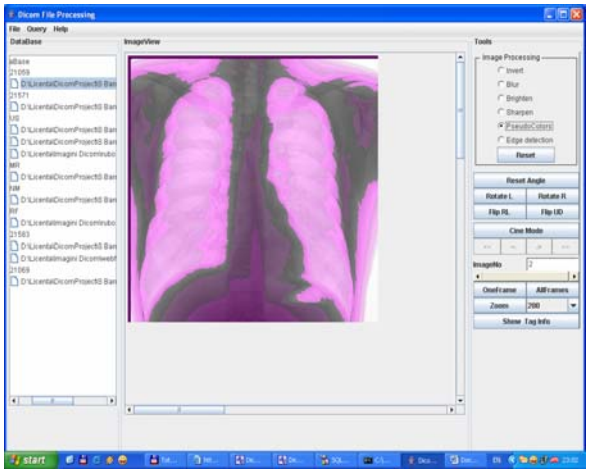

Fig. 7. Application of the Pseudo Colors function

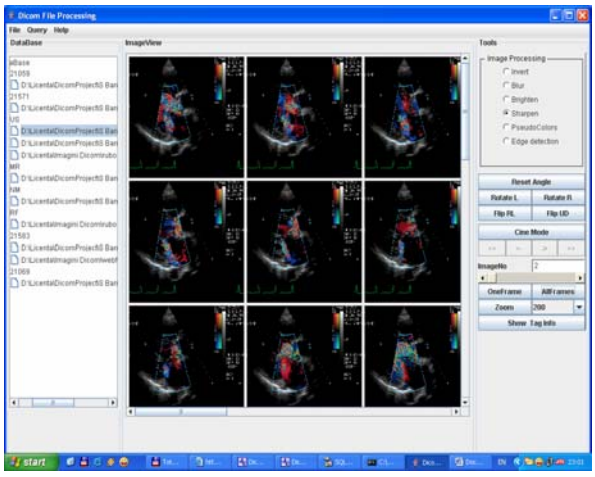

Fig. 8. Viewing all the frames from the DICOM file

The sharpen function doesn't really "sharpen," it finds areas where pixels change in color or brightness and increases the contrast between the adjacent pixels [5].

The invert function inverts an image: pixel values of 0 become 255 and pixel values of 255 map to 0 [5]. The result is to invert the tonal scale of an image.

The main frame, presented in figure 6 contains the following:

1. A DataBase Panel that has a tree view of all the file path of the DICOM files from the MSSQL database. The files are sorted by their modality (CT, MR, US and so on). When clicking a file path, the frame (or the first frame in case of multi frames) of that file is shown in the ImageView Panel;

2. An ImageView Panel. When double-clicking the file path from the tree view, the first frame (in case of multi frames) or the frame from the Dicom file is shown in the ImageView Panel. The panel is also used to show the frame (or frames) of the file after image processing functions.

3. A Tools Panel, which contains several image processing functions. It is composed of:

3.1 An Image Processing panel which contains a Checkbox Group with image effects functions:

3.2 Some Rotate and Flip buttons used by physicians to determine the area of interest:

3.3 A Text Area and a Slider used for multi frame Dicom files. In the Text Area the number of the current frame is shown. The Slider dynamically changes with the Dicom file displayed. It can also be used to see a particular frame.

3.4 A Cine Mode option. By clicking this option a multi frame file can be viewed as a motion picture. It can be used by physicians when studying the human heart and not only.

3.5 OneFrame and AllFrames buttons used in case of multi frame Dicom files. By pressing AllFrames button all frames will be displayed. By pressing OneFrame, only the first frame of the file will be displayed

3.6 Show Tag Info button that will open a new frame where all Dicom file tags are displayed by category.

4. The Dicom Tag Browser frame contains a list where all the categories are displayed. By double clicking one of them, all tags from that category that were found in the Dicom file are displayed, together with all their information and value. It is possible that for a category no tag can be displayed, because no information was found in the file. The tags and all their information are taken from the database where they were stored after the file had been processed.

5. Adding a Dicom file to the database is done by selecting [File| Add a Dicom File]. The dicom file package will be used to decode the Dicom file, save the images as jpegs or gifs and store the tags and the paths of the images in the database. When decoding is done, the file is added in the Database tree. It can be selected and the frames will be displayed in the ImageView panel.

5. If Dicom Dictionary has to be seen, select [Help| See Dicom Dictionary]. A frame will be displayed with all the tags from the dictionary sorted by category.

VI. THE FLEXIBLE TEXT-BASED QUERY OF THE DATABASE

It was mentioned that the database structure was built to allow a text-based flexible query. A flexible query is a query that uses as parameter any of the data types from the DICOM file. The conditions given in the query can be connected with the logical operator "AND".

There is a list type control in the query window, which has as articles the names of the information types from the data dictionary. There is also a text type control, which will be filled with the string that will be searched in the database among the values corresponding to the selected type of information.

For example, if the selected tag is Patient name, and in the text control is typed the value "Popescu Ion", the query will return all the records from the database which have this value in the same tag.

Consequently there will be found the information and the images corresponding to the patient with the name "Popescu Ion" obtained during his consultations that were recorded into DICOM files along the time and recorded in the database afterwards.

The query process may continue in the same manner, the conditions from Where clause of corresponding SQL Select command, being merged through the logical operator "AND".

It can be observed the existence of the Select command, which is built, in a dynamic mode, in terms of the conditions selected by the user [7]. In fact, there aren't any limitations of the conditions or of their number, which gives a big flexibility to the query. In figure 9 appears the window, which allows a text-based query.

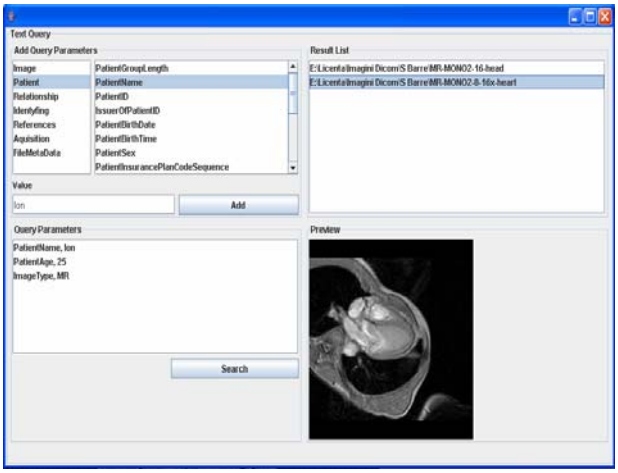

Fig. 9. Text based query of the database

VII. CONCLUSION

The article presents a software tool that allows computer viewing and manipulating of the standard DICOM files generated by the medical devices used in the diagnosis process. One of the functions is the extraction of the alphanumeric and imagistic information from the DICOM files and their storage in a Ms SQL Server database.

The second function is the visualization in a better form of the extracted and stored information.

In order to improve the image quality and to support the diagnosis process, several functions can be applied. Also, the database can be subjected to the simple text-based query.

The advantage of this Java based software tool [8], [9] is the fact that all the extracted information is stored in a database, which is advantageous in the process of recording the patient evolution.

The simple text-based query can be completed with the content-based visual query on color and texture characteristics. Once the images have been extracted from the Dicom files, stored in the computer and indexed in a database, they can be subjected to a process of extracting color, texture or shape characteristics. These can be further used in the content-based visual query. Consequently, the software tool can acquire new interesting and modern uses in the diagnosis process, in research or medical studies.

The application is tested now by the Romanian medical personnel taking into consideration aspects like execution speed, retrieval quality and new necessary options.

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A telemedicine Framework for Collaborative Pacemaker Follow-up

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Abstract-According to international guidelines implanted pacemakers need to be checked periodically to ensure that they are working correctly. To spare a significant number of patients the burden of having to travel to specialized hospitals as well as to increase efficiency in pacemaker therapy a telemedicine framework has been developed prototypically. The purpose of this study has been to use a routine ECG recording to verify whether the pacemaker works correctly or if further examination is indicated. The telemedicine framework enables an active collaboration between the caregiver in the vicinity of the patient and the specialist at the hospital. The concept has been evaluated in a clinical pilot trial on 24 consecutive patients with a total of 17 different pacemaker models from 6 different manufacturers. The promising results indicate that the presented, manufactured independent follow-up concept, which can be handled by general practitioners, has the potential to work as an efficient screening method to identify possible problems as early as possible.

I. INTRODUCTION

Pacemaker (PM) implantation is only the first step in the therapy of patients suffering from several heart rhythm diseases like bradycardy, sick sinus syndrome, and AV-node dysfunction. It has been estimated that in Austria about 50.000 patients have permanent pacing systems and that there are about 3.000 implantations of new pacemakers per year.. Since the patient's life may depend on the pacemaker, both patient and device need to be examined in periodic intervals according to the international guidelines [1]. Thus, PMs are to be inspected up to four times a year, depending on the duration of PM implantation, the patient's general condition and the results of previous follow-ups.

In the course of most of these follow-ups – so-called "basic follow-ups" – mainly the depletion level of the PM's battery, the basic function of the PM as well as patients' general conditions are assessed.

Only in a minor number – mostly during the first year after the implantation – more comprehensive procedures are necessary in order to adjust PM settings to the individual needs of the patient as well as to optimize the pacing system concerning power source utilization. These procedures – so-called "extended follow-ups" – are performed in specialized PM clinics. Therefore company specific, cost intensive PM programming systems are required, which allow communicating with the implanted PM telemetrically,

Since there is no method to check the basic function of the pacemaker in an easy and uncomplicated way, currently only "extended PM follow ups" are performed in Austria. This implies a huge personal effort for the departments and long travel burdens for the usually elderly persons to undergo this routinely performed examination. A screening examination would be helpful that is able to identify possible problems with the PM as early as possible without the need for the patients of travelling to the PM clinic for extended PM follow-up.

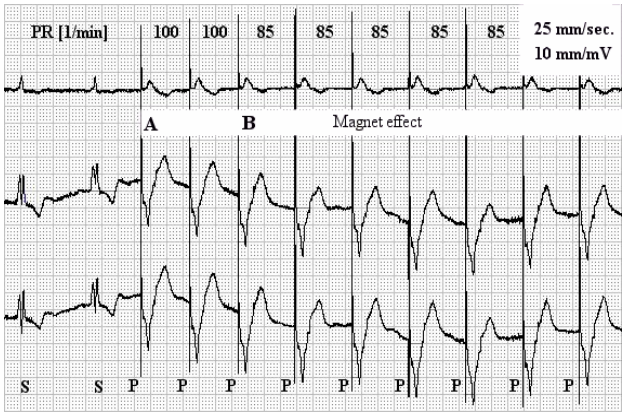

Figure 1. Example of an ECG sequence recorded during magnet placement from a patient with a Medtronic Kappa pacemaker; A: magnet takes effect (PR=100 min^{-1}); B: after the 3rd stimulus the PR lowers to 85 min^{-1} indicating BOL.

The general idea of the project is to shift a significant number of "basic PM follow-ups" from follow-up centres to caregivers located in the patient's vicinity. This is based on the fact, that "basic follow-ups" can be performed without the necessity of manufacturer specific PM programming devices.

Due to international standards each device reacts to the application of a magnet by changing the pacing rate in a predefined way – depending on the depletion level of the

battery and on the type and manufacturer of the PM (figure 1). Therefore, a routine ECG recording can be used to verify whether the PM works correctly or if further examination is indicated.

II. METHODS

Figure 2 shows the general overview of the developed telemedicine framework for remote, manufacturer independent PM follow-up.

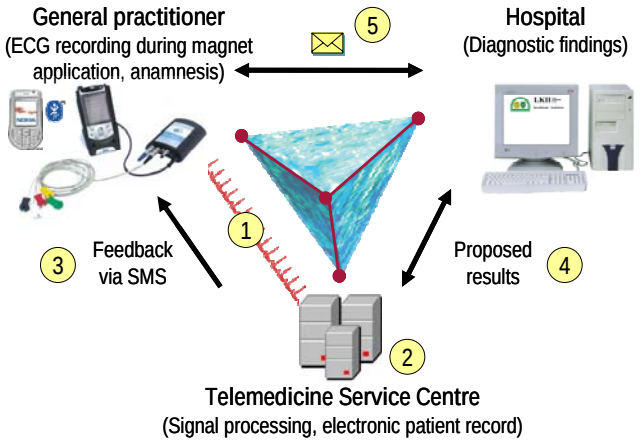

Figure 2. Overview of the telemedicine framework for manufacturer independent, collaborative pacemaker follow-up.

Basically, the telemedicine framework supports the collaboration between the cardiologist at the hospital and the primary care physician at the point-of-care. It supports the following processes at the participating sites:

- Caregiver at the point-of-care
  Access to patients' health records via wireless internet
  Recording of an ECG during temporary magnet application
  Documentation of anamnesis data
  Transmission of the data to the telemedicine service centre
- Telemedicine Service Centre
  Management of PM therapy related data (electronic patient record)
  ECG signal preprocessing
  Automated generation of a preliminary medical report
- Specialized cardiologist at the PM-Clinic
  Access to patients' health records and medical history
  ECG and data review via web-interface
  Generation of the final medical report

Point-of-care: Mobile Pacemaker Follow-up Unit

To provide the caregiver at the point-of-care with an adequate communication interface a mobile PM follow-up unit has been developed. The data acquisition unit comprises of the following components (figure 3):

- Personal digital assistant (PDA)
- Mobile, PDA based ECG recording system
- UMTS enabled mobile phone

The PDA acts as mobile client, in order to have access to relevant patient data via the mobile network. Additionally a special software, running on the PDA, provides the physician with the necessary functionality to perform the PM follow-up examination. The PDA is connected to a UMTS enabled mobile phone (phone model: Nokia 6630) via a Bluetooth connection. Hence, the mobile phone acts as a modem for the PDA to establish the wireless internet connection to the telemedicine service centre.

A specially developed, JAVA [2] based software running on the PDA provides the physician with an easy to use graphical user interface. The software application guides the user through the PM follow-up procedure. After login and authentication process, the user selects the appropriate patient and a new follow-up session is initialised. Thereafter the user is asked to record a standard ECG. Mobile ECG acquisition is supported by a PDA based ECG signal recording unit ~~, provided by g.tec – Guger Technologies OEG~~ (g.mobilab, g.tec Guger Technologies OEG, Graz, Austria). The mobile ECG amplifier provides a two channel ECG recorder. Each channel is sampled with 256Hz and the recorded ECG is stored and assigned to the patient. During the recording a magnet has to be placed above the PM case to trigger the magnet mode for a period of about 30 seconds. It is important to collect as much information as possible for every recording, so that signal processing can be done in a reliable way. Thereafter the physician is asked to acquire anamnesis data electronically. Finally the ECG and anamnesis data are sent to the telemedicine service centre automatically via the mobile network (figure 2 - 1). UMTS connection guarantees a theoretical upload rate up to 64 kBit/s.

Figure 3. Data acquisition and transmission equipment. ECG signals are recorded with a mobile biosignal acquisition system (g.mobilab, g.tec – Guger Technologies OEG) that is connected with a PDA. A mobile phone is used for sending the ECG to the telemedicine service centre.

Telemedicine Service Centre

Received files and anamnesis data are stored and managed by the application-server automatically (figure 2 - 2). The

ECGs as well as anamnesis data are stored into the database waiting to be fetched and processed by the signal processing unit.

During signal processing relevant information are extracted from the ECG (e.g pacing spikes are detected, spontaneous and paced beats are classified, and the RR-intervals, representing the magnet effect, are calculated). A matching process compares the PM specific stimulation patterns for begin of life (BOL), elective replacement indicator (ERI) and end of life (EOL) with the sequence of RR-intervals. The PM specific stimulation patterns are stored in the PM database which contains the individual patterns for BOL, ERI, and EOL for every PM. The processing results provide an estimation of the depletion level of the battery of the PM. The underlying algorithm has already been evaluated and published in [3, 4]. Regarding the overall outcome, three different cases were classified:

- "ok": the BOL stimulation sequence has been detected definitely.
- "replace": the ERI / EOL stimulation sequence has been detected definitely.
- "undefined": In spite of repeated ECG recording no appropriate stimulation sequence could be identified.

The results of the signal processing are stored into the central electronic PM patient record (EPPR) and are available for the physician at the point-of-care. Additionally, the results are sent to the data acquisition unit via SMS immediately (figure 2 - 3).

In case of an "undefined" result, the user is asked to record the ECG with temporary magnet application once again. In case of "replace" a possible problem with the PM is indicated. This means, that the patient has to be admitted to the PM clinic immediately for further examination. On the other hand, "ok" indicates a successfully performed "basic PM follow-up" examination without any problems. The proposed preliminary results have to be confirmed by the cardiologist. Based on the outcome and the patient's medical history, a date for the next follow-up is suggested.

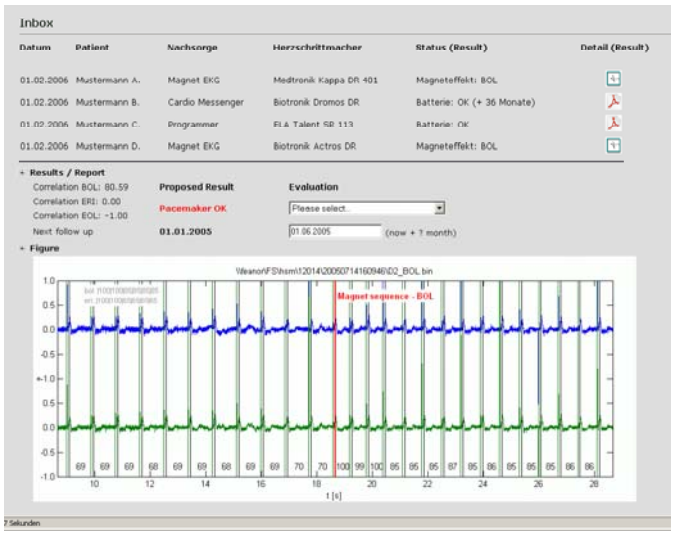

Figure 4. Screenshot of the preliminary report that is presented to the cardiologist via web-interface.

Pacemaker Clinic: Review Process

A preliminary report is proposed to the cardiologist via web-interface (figure 2 - 4). The report includes patient related data, information about the implanted pacemaker as well as the results of the automated ECG processing. Additionally, the recorded ECG is also presented to the cardiologist. Relevant parameters as well as critical episodes of the ECG are highlighted in order to focus the cardiologist's attention. A screenshot of a preliminary report, presented via web interface, is shown in figure 4.

After acceptance or correction of the suggested results for the working status of the PM and of the next follow-up date a final report is generated and stored into the EPPR. The report is available for the primary care physician who contacts the patient (figure 2 - 5). In case of an unclear situation the patient is admitted to the PM clinic for further examination immediately.

Telemedicine Framework IT - Infrastructure

Additional to the ECG processing unit the telemedicine service centre hosts the basic IT infrastructure to provide the core functionality for the telemedicine framework:

- Core Services
  An application server manages basic services like user management, data management and general security issues. Additionally, services like report generation or an integrated ECG viewer are also provided.
- Electronic Pacemaker Patient Record (EPPR)
  General PM related data and PM settings are stored into the EPPR. The EPPR basically provides the functionality of an electronic health record and adds services for the management of PM therapy related data. The EPPR hosts the results of previous performed PM follow ups and the medical history of the patient. The specific device, as well as medical reports and diagnostics findings are linked to the appropriate patient..
- Interface to mobile pacemaker follow-up client
  The system provides several interfaces to provide information to as well as to retrieve data from mobile clients, like our developed mobile PM follow-up unit. Data is exchanged by remote procedure call (RPC). This XML based protocol provides a fast and secure data exchange over the (mobile) internet. On the other hand ECG files are uploaded by standard file transfer protocol (FTP).
- Web – Portal
  A web-server provides the user with an interface to access and manage the data stored into the EPPR (figure 3). For example, received ECGs, which were recorded in course of an external PM follow-up examination, are listed in the so called "Inbox".

Pilot Trail

In course of the pilot trail the proposed telemedicine framework for remote PM follow-up has been evaluated in

clinical environment. Previous to the routinely PM follow-up examination at the PM clinic the patients were asked to undergo the remote follow-up procedure described above. According to the study protocol the examination has been performed separately without the presence of the cardiologist. The feedback and results of the remote signal processing have also been hidden to the cardiologist and compared to the standard decision for evaluating the overall usability of the remote follow-up concept.

III. RESULTS

The presented telemedicine framework for manufacturer independent remote pacemaker follow-up has been evaluated in a clinical pilot trial with 24 consecutive patients (10 female, age 75 +/- 13 years) on four days. A total of 17 different PM models from 6 different manufacturers (Biotronik, Medtronic, Vitatron, St. Jude, ELA, Intermedics) were analysed. The mean implantation duration was 16 months (min: 0 month, max: 132 month). 17 out of 24 patients were classified as "OK". In spite of repeated ECG recording and analysis 7 PM were classified as "UNDEFINED". In the course of the standard follow-up procedure all PM were classified as "OK" by the cardiologist.

Overall 58 ECGs (file size 63 +/- 17 kByte) were recorded and sent to the telemedicine service centre via the 3G UMTS network. Averaged transmission time was 9 +/- 2.8 seconds; averaged signal processing time was 9 +/- 4 seconds. During the study period there were no problems with signal transmission or the availability of the UMTS network. Feedback of the results of the signal processing unit via SMS was available within a maximum of five minutes.

IV. DISCUSSION

The promising results of the initial clinical pilot trial show the potential of a telemedicine framework for remote pacemaker follow-up. The presented application provides a prototype of a manufacturer independent, remote PM follow-up unit to identify whether the PM works correctly or further examination is indicated. However, the results of the pilot trail were limited due to the following factors:

- To perform an automatic analysis of the magnet effect it is essential that the typical stimulation pattern for each depletion level of the battery and pacemaker are stored in the database. Because of a lack of database update 7 patients (6 PM) could not be analysed online because the PM were not registered in the database. Hence the examination could not be performed prospectively.
- A correct identification of the pacing spikes is essential for identifying the stimulation pattern within the ECG. In the pilot trail, the ECG recording device used supports a sampling rate of 256 Hz, which seems to be too low – especially in case of bipolar stimulation – to detect the pacing spikes correctly. Hence 7 PM could not be evaluated.
- Unfortunately no PM indicated ERI or EOL during the study period. Further studies should also include a respective patient group (pacemakers with identified problems) in multi institutional study setting.

The fact that during the study period no PM indicated ERI or EOL confirms the need of an efficient screening method to identify possible problems with the devices in the vicinity of the patient. By reviewing the medical history of the patients it turned out that only in about 10 out of 100 cases an extended follow-up is indicated. Providing an easy to use follow-up unit as presented in the paper gives the caregiver at the point-of-care the opportunity to perform a basic follow-up in cooperation with the specialist at the PM clinic.

Shifting tasks from specialized clinics to the health care providers at the point-of-care increases on the one hand the efficiency in therapy management and reduces the burdens for the patients. On the other hand an increased effort on communication and collaboration between both participants is required. In the case of the proposed PM follow-up framework the face to face contact as well as data acquisition will be shifted from the specialist to the primary care physicians. This means that the patient and his data ways can be separated. This could be convenient for the patients and disburden the specialists at the same time.

Beside providing an efficient screening method the framework provides an EPPR where PM therapy related data like PM settings or medical history of the patient are stored and managed centrally. An Internet based user interface gives the cardiologist access to the data and the opportunity to add the results of an extended follow-up to the EPPR. Hereby a consistent documentation regarding to quality assurance guidelines is ensured.

Nevertheless, the ultimate goal to reduce the expenses for the public health system and to reduce the travel burdens for the usually elderly patients seems to be achievable in the near future. The results indicate that the presented follow-up concept, which can be handled by general practitioners, has the potential to work as an efficient screening method to identify possible problems as soon as possible.

ACKNOWLEDGMENT

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Classification for Methods of Telemedicine Efficiency Investigations

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Abstract This article was prepared for the review and primary generalization of methods for telemedicine efficiency investigations (MTEI). Classification of MTEI had been developed: 1.Clinical MTEI: investigation of establishment activity efficiency; investigation of diagnostic, treatment activity and outcomes efficiency; investigation of diagnostic accuracy; investigation of moral efficiency. 2. Non-clinical MTEI: investigation of economical efficiency; investigation of psychological status; investigation of technical efficiency; investigation of management efficiency. Hope this classification will be useful for planning of scientific researches in telemedicine.

I. Introduction and Aim

The telemedicine is promptly integrated into system of public health care. It is very important to investigate telemedicine efficiency for better decision making and creation of "evidence-based telemedicine".

Dr.Noriaki Aoki et al. propose classification of "telemedicine results" [1]:

1.Clinical results:
- clinical efficiency,
- patient satisfaction;
- diagnostical accuracy;
- cost.

2. Non-Clinical results:
- technical evaluation;
- management evaluation.

Aim of this paper – development of classification for methods of telemedicine efficiency investigations (MTEI).

II. Materials and Methods

Materials: results of 300 teleconsultations (15 medical specialities) [13-15], references [1-12,16-18].
Methods: analytical analysis.

III. Results

Author's classification for methods of telemedicine efficiency investigations:

1. Clinical MTEI:
– investigation of establishment activity efficiency;
– investigation of diagnostic and treatment activity, outcomes efficiency;
– investigation of diagnostical accuracy;
– investigation of moral efficiency.

2. Non-clinical MTEI:
– investigation of economical efficiency;
– investigation of psychological status;
– investigation of technical efficiency;
– investigation of management efficiency.

We hope this classification will be useful for palnninig of scientific researches in telemedicine. Statistical methods for investigation: comparison, analysis, kappa, receiver operating characteristics (ROC) curves, mathematical modelling.

Clinical MTEI

Investigation of hospital/institutional activity efficiency

Statistical comparison of various parameters of medical establishments' activity (comparsion telemedicine and standard ways for medical care). Here can concerns: level of surgical activity (on the background of telemedicine usage), parameters of death rate and mortality, duration of a pre- and in-hospital stay, etc. For example, earlier we had lead comparison of parameters at two groups of patients with polytraumas, thus in one of groups teleconsultation for definition of tactics of treatment and preventive maintenance of complications was spent. Such parameters of activity of medical establishment, as were considered: duration of hospital stay and parameter of repeated hospitalization [14]. Main MTEI: statistical comparison of parameters with and without telemedicine.

Statistical methods for investigation: comparison.

Investigation of diagnostic and treatment activity, outcomes efficiency

Searching for statistical dependences and comparison for various parameters, for example: quality of outcomes, level of complications, level of clinical mystakes, death rate and mortality, dynamics of results of laboratory tests, quality of life, survival rate, anthopometry changes. Interesting way of studying of telemedicine efficiency –comparison of series of the teleconsultations for the same clinical cases or problems. Thus it is given to advisers either the same clinical case (it is the most effective!), or patients with similar statuses.

Similar researches in a blind variant are most effective. For example, for studying efficiency of second-opinion [6] has lead a series of teleconsultations concerning tropical medicine. The same clinical case has been directed to various physicians. Then results (duration for answer, adequacy of the conclusion etc) has been evaluated. Another example, [18] have lead comparative studying laboratory clinical parameters and weights of a body at patients with a diabetes. High efficiency of application of the home telemedicine is revealed. Main MTEI:

- statistical comparison of clinical results with and without telemedicine;
- statistical comparison of medical practitioners activity with and without telemedicine;
- series of teleconsultations for same clinical cases.

Statistical methods for investigation: comparison, analysis, kappa.

Investigation of diagnostical accuracy

The comparative analysis of:

1) quality, accuracy and specificity of diagnostics,
2) description of the local status,
3) and recommendations for treatment with or without telemedicine [9,17].

A few groups of medical experts works with series of visual materials (x-rays, tomograms, digital photos) via telemedicine and by standard way. After that researcher is compare and statistically investigate experts' opinions. Also, spend comparison of diagnostic value for digital images with various characteristics (size, resolution, color etc) [12].

Main MTEI:

- statistical comparison of diagnostical accuracy for medical visualisation with and without telemedicine;
- comparison of quality of the patient's examination by attending and distant experts;
- comparison of diagnostic value for digital images with various characteristics.

Statistical methods for investigation: receiver operating characteristics (ROC) curves, comparison, analysis.

Investigation of moral efficiency

Estimation of moral efficiency or satisfaction of patients and doctors by telemedicine. For an estimation of satisfaction of the patient use various questionnaires and test, like [8]: SF-36, Ware Specific Visit Questionnaire, Patient Enablement Instrument, Short Form-12 etc. For the doctors, which practice telemedicine, had developed special questionnaires, for example, Questionnaire of the UTHSCSA [11].

Main MTEI:

- questioning with statistical processing results;
- interview with recording and statistical processing of results.

Statistical methods for investigation: kappa, analysis.

Non-Clinical MTEI

Investigation of economical efficiency

There are methods for estimation of economic efficiency of the telemedicine [1]:

1) cost-minimization;
2) cost-effectiveness;
3) cost-utility;
4) cost-benefit analysis.

Methods 1 and 2 - comparison of expenses, for example, on the organization of consultation of the patient in establishment of higher level by the traditional way and by telemedicine. Other widespread way of an estimation - studying of economical effectiveness due to changing traditional care to telemedicine. It is recommended to economic analysis of telemedical activity with use of classical methods - methods of minimization of expenses, the analysis of expenses and productivity, the analysis of expenses and benefit, the analysis of expenses and utility.

There are some methods for economic efficiency investigation:

1) Formula for definition of the cost of telemedical service by Kamaev et al. [15].
2) Formulas for definition of annual charges for telemedicine and for usual medical service by Djedjelava et al. [15].

Researcher can make comparative financial studying of telemedicine and usual system of health cares. For example, asynchronous teleconsultation and service by advisers which leave to patients on cars [14]. Quite adequate method is comparison of the price and amortisation charges on various kinds of the equipment [3]. Profitability is studied in combination with other quantitative and qualitative characteristics - quality and survival rate, clinical parameters, etc. So, it is spent not only comparison of expenses, but also "qualitative-quantitative benefit" of telemedicine usage. The expediency is studied together with other qualitative characteristics (for example, quality of a life in a combination with parameters of clinical efficiency). It is "qualitative benefit " uses of expenses [1].

Main MTEI:

- definition of the costs for telemedical service and comparison with same usual medical service;
- comparison of cost and charges for usual and telemedical health care at operation of various kinds of equipment;
- economical estimation and comparison of the telemedical and usual form of health services;
- complex estimation of economical and qualitative efficiency (expediency);
- complex estimation of economical, qualitative and quantitative efficiency (profitability).

Statistical methods for investigation: comparison, analysis, kappa.

Investigation of psychological status

The important and interesting aspect - research of the psychological status of various participants of telemedical procedures (patient, remote adviser, attending physician, coordinator, support personnel). It is possible to use different test for this aim – Lusher's, Spielberg-Khanin's, Scale of Uneasiness, "technique for multilateral research of the person", "multifactorial estimated scale of psychosocial changes", etc). It is quiet new field for investigations in telemedicine activity.

Statistical methods for investigation: comparison, analysis.

Investigation of technical efficiency

Testing of the equipment - [10] has carried out research of the equipment for videoconferences by transfer of series not-medical images. Comparison of accuracy of various telemedical systems (videoconference, e-mail) - volumes, speed of transfer of the information, loss of quality, an opportunity of registration etc.

Statistical methods for investigation: receiver operating characteristics (ROC) curves, comparison, analyis.

Investigation of management efficiency.

For an estimation of management efficiency of the telemedicine in comparison study [1]:

- time parameter (duration of medical procedure, visit, detour, survey, etc.);
- quantity, duration, productivity of transportations of patients between medical institutions of a different level.

Statistical methods for investigation: comparison.

IV. CONCLUSION

Thus, classification for methods of telemedicine efficiency investigations had been created. A following stage of our research - creation of special system (algorithms) for telemedicine efficiency investigations for clinical, scientific practice and decision making.

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Session 7

Telecardiology

Transtelephonic ECG, Different Approaches The Aerotel Experience

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Abstract- Aerotel Medical Systems manufactures and develops Transtelephonic ECG monitors which are supported by its remote receiving software enabling the Diagnosis and the management of the data received from those monitors. Its clientele is spread out through the World, from the Far East to North America, and have managed through the years to develop different applications and Business models for the same type of monitors, thus making it one of the most flexible and a world leader in cost effectiveness. This presentation will provide a review of the various Heart monitors and the different approaches that the different users have opted, showing the various business models available in telemedicine. The presentation will be supported by video examples of various call centers.

Telemedicine: transtelephonic ECG, remote care, patient monitoring, Tele-cardiology, Cardiac monitoring

A Wireless PPG Sensor Applied Over the Radial Artery – A Pilot Study

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Abstract - Photoplethysmography (PPG) is a well known non-invasive technique in the medical field. It is mainly used for monitoring skin perfusion and oxygen saturation. PPG measures changes in intensity of light that has been emitted into the skin and reflected or transmitted towards a photo detector. There is no exact knowledge of the mechanisms behind the PPG signal but it has been suggested that the pulsatile component is related both to pulsatile volume changes due to varying lumen of the vessel and to red cell orientation during each cardiac cycle.

A specially designed wireless PPG sensor has been developed for application over the radial artery to gain centrally related blood flow variables. A study was performed to assess the relationship between the PPG signal and several physiological parameters. Recordings were made using an arrangement of a Doppler ultrasound probe, a non-invasive blood pressure measuring device (Portapres), an impedance measuring device that records respiratory work and a wireless PPG measuring device attached over the radial artery. All signals were recorded simultaneously and analyzed afterwards.

The measurements showed a close relationship between the recorded variables. The strongest correlation was found between pulsatile PPG and blood velocity (measured by Doppler ultrasound). This correlation was most obvious during hyperventilation. In this case there was also a strong correlation between PPG and blood pressure measured by Portapres. The recordings also showed that forced deep respiration could be observed both by PPG and Portapres.

In conclusion;

- **the PPG signal may reflect blood pressure variations as well as a velocity related component in the radial artery**
- **respiratory events may be observed in the radial artery using PPG**
- **the wireless PPG sensor system is a new tool for monitoring centrally related physiological parameters but with limited battery lifetime as a drawback**

Keywords: Blood pressure, Blood velocity, Non-invasive, Photoplethysmography, Wireless

I. Introduction

If monitoring is to be applied in the patient's home, recording of complications are of great importance. A wireless communication device, sending information from the PPG sensor through e.g. a cellular phone to the hospital may increase the security for the patient and the acceptance from the patient's relatives and personnel.

Photoplethysmography is a method that utilizes optical radiation to measure changes in blood perfusion in the intravascular volume. It was first described by Hertzman and Clair in 1937 [1] and has been developed since. It usually consists of at least one light emission diode (LED) and one photo detector. The light emission from the diode passes into the skin and is absorbed, scattered and reflected in different proportions by dermal tissue, vascular tissue and blood. It is believed that the intensity of the reflected and scattered light recorded by a photo detector reflects changes in blood flow and blood volume in the tissue being examined [2].

The signal obtained from the PPG-sensor consists of a DC (low frequency) and an AC (high frequency) component. The DC component is assumed to reflect the local blood volume changes of the examined tissue and the AC component is believed to reflect the pulsatile part of the blood flow synchronous with heart rate [3, 4].

Although it is generally accepted that PPG monitors changes in blood flow, there is no exact description of the relation between the signal and the blood flow. Earlier studies on in vitro models indicate that the pulsatile part of the PPG signal varies both with blood volume changes (dilatation of vessels) and with red cell re-orientation during each cardiac cycle. The latter property varies in turn with the red cell velocity, which indicates that the AC signal also contains a velocity related component. PPG is used in both clinics and research today. It is mostly used in pulse oximeters for determination of oxygen saturation [5].

The most obvious characteristic in the PPG signal is the pulse frequency and the signal is directly influenced by the

heart rate and stroke volume [6]. Another common characteristic in the PPG signal is the dicrotic notch, usually shown as a peak following the pulse peak but with smaller amplitude. This notch is now believed to be an indicator of vasomotor tone but it is classically attributed to closure of the aortic valve at the end of ventricular systole [6]. Respiratory related variations can also be seen in the PPG signal e.g. as a baseline deviation that closely follows the respiratory phase. Low frequency auto regulatory features may also be observed in the PPG signal.

Non-invasive continuous recording of blood flow related parameters on the wrist are now possible using photoplethysmography (PPG) and a custom designed wireless sensor. The function of the wireless sensor and the specific relationship to blood pressure/blood flow was evaluated in healthy subjects.

II. MATERIAL AND MEASUREMENTS

A. The Wireless PPG sensor system

The hardware used in the PPG sensor system was based on a general board meant for wireless measurement applications. This board was designed at the department and is named Bluetooth platform.

The platform includes:

- Battery, Li-Polymer 550 mAh
- Charger
- Voltage converters to power all circuits and external hardware used in a custom application.
- Bluetooth module to setup the wireless connection. (Free2move F2M03AC2)
- 16 bit, 100 kHz Analogue to Digital Converter (Texas Instruments ADS8341E)
- Microcontroller that can run the platform functions as well as a custom application and sending data to the Bluetooth module (Atmel Atmega168)

In addition to functions listed above the platform must be small, have low power usage and a low noise level. The noise during sampling and continuous transmission of data over Bluetooth was approximately to 0.5 mV. This corresponds to an effective resolution of 13 bits.

The sensor consists of two light emitting diodes (LED) with a wavelength of 810 nm (L810-05AU, Epitex, Amsterdam, The Netherlands) and one photo detector (BPW 34, Siemens, Munich, Germany).as seen in Fig. 1. The distance between the LEDs and the photo detector was 7 mm. The shield prevented light from passing directly from the LED to the photo detector.

The LED in the sensor illuminates the tissue at a constant radiant power and was fed from a +5.05V source.

The photo detector current was amplified in a current-to-voltage converter to establish the PPG signal and was further amplified using a programmable amplifier. After the DC amplifier the DC-portion of the signal was cut off using a passive RC-filter and the remaining AC-signal was amplified using a second programmable amplifier.

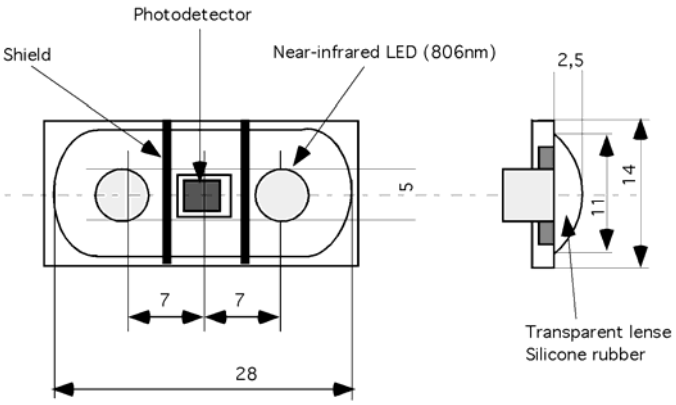

Figure 1. A schematic view of the PPG sensor. All units in m.m.

The Bluetooth module had a complete built in Bluetooth stack and used a special UART protocol to set up the transmission speed to 460 kbit and wait for the PC to setup the Bluetooth link. As soon as the link was established, it started to listen to commands from the PC program at the UART port from the Bluetooth module.

The application was controlled by the PC-program (LabView, National Instruments, Texas, USA). After receiving a start-command, the program on the platform began sampling data and send it over Bluetooth to the PC. The data was sent in packages of six bytes, two synchronization bytes, two bytes for DC and two bytes for the AC part of the signal. The transmission could be stopped at any time to e.g. set new gains.

B. The Portapres blood pressure reference

The Portapres (TPD Biomedical Instrumentation. Amsterdam. The Netherlands) is an apparatus that monitors blood pressure in the finger by using a silicone filled cuff and IR-light. Peñàz first described it in 1973 [7]. The mean arterial pressure is found as the maximum unloading occurs using a photoplethysmograph. From this state the cuff pressure is continuously adjusted by a servo controlled system, to make the pressure in the cuff to follow the blood pressure. The measurements are performed to one finger at the time and switches between the two fingers at predefined intervals in order to avoid discomfort for the patient. There is, however, a difference between pressure waveforms at different points toward the periphery. This is because of reflections of the systolic pulse wave in the arterial system of the arm. [8] In the study conducted by Rongen et al. [9] and the study performed by Harms et al. [10] pressure waves at different locations are compared. There seems to be a slight difference between the brachial and finger pressure and the difference seems to be more distinct in elderly patients. There is also, because of the pressure wave propagation, a small delay between the two pressure waves. Correction functions can be used to match the brachial and finger pressure better [11].

C. Pulsed Doppler velocimetry

Blood velocity and vessel diameter was measured just below the PPG sensor using pulsed Doppler velocimetry (ATL, HDI, 5000, L12-5 Philips, Germany). A flat probe (operating frequency 4 MHz) was held against the skin over the radial artery as seen in Fig. 2. The peak velocity was

recorded in six second intervals and saved as images. The diameter of the vessel was also determined by the Doppler machine. Finally, from these two variables the peak blood flow was derived.

D. Transthoracic impedance monitoring

A common method for respiratory monitoring is transthoracic impedance plethysmography monitoring. A method of determining changing tissue volumes in the body is to measure the electric impedance at the body surface [12]. Respiration causes a variation in air volume within the lungs. This results in variation in the transthoracic impedance which is possible to monitor with three ECG-electrodes positioned on the thorax[13]. The measurements were performed with a transthoracic impedance monitor from Hellige, Germany.

E. The measurements

Five healthy subjects were used in the study, age ranged from 25 to 28, one female and four male subjects. An ethical application was approved. The measurements were performed with the subject in a supine position. The measurements commenced with the subject performing forced deep respiration, followed by few minutes of normal respiration and ended with a short period (approximately 30 seconds) of hyperventilation.

The PPG-sensor and the Portapres were attached to the left arm of the subject. The PPG over the radial artery, just below the hand, and the Portapres was attached to the middle phalanx of the middle- and ring finger. Doppler ultrasound measurements were performed on the same arm, below the PPG measurement site as seen in Fig. 2. Impedance electrodes were attached on the chest.

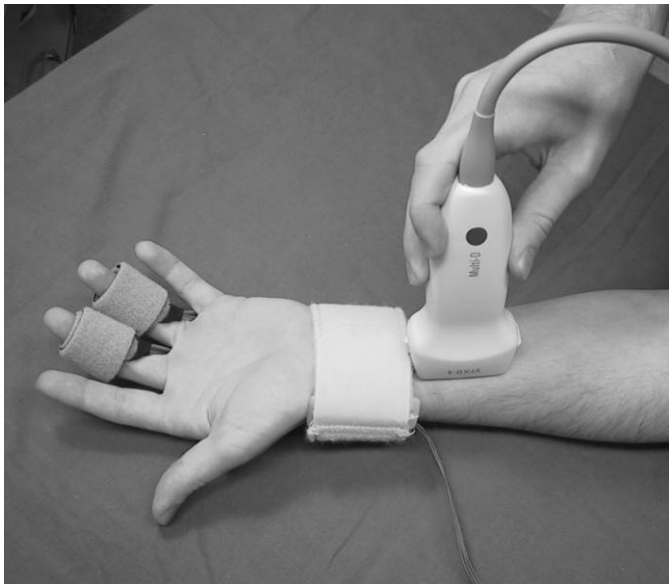

Figure 2. The measurement setup. The PPG sensor is positioned over the radial artery under the strap band. The lead from the PPG sensor (bottom of the picture) was connected to the Bluetooth unit. The Portapres blood pressure measuring cuffs were attached to the middle- and ring finger and the Doppler ultrasound probe was placed below the PPG sensor.

The analogue Portapres blood pressure signal and the impedance signal (respiration) were collected using an A/D-card (DAQCard-6062E National instruments, Texas, USA) sampled at 75 Hz by the same LabView application as for the PPG. An ordinary laptop was used for data acquisition. The ultrasound velocity and diameter were extracted from images collected using pulsed Doppler. The images consisted of 468 pixels in signal length which, with a measuring interval of six seconds for each image, resulting in a theoretical sampling rate of approximately 75 Hz.

A trigger pulse was used to synchronize the ultrasound data with the other variables. This pulse was sampled parallel with the Portapres and impedance signals. For each trigger value, corresponding to an ultrasound image and six seconds of the PPG, Portapres and impedance signals, data was synchronized and saved as images.

The computational software used was MATLAB (Mathworks, Massachusetts, USA).

III. RESULTS

A. The wireless PPG sensor system

The total system was also, besides the measurements, assessed with regard to battery time, range of wireless connection and electromagnetic interferences. The battery time was approximately 5 hours and 15 minutes. Range of wireless connection was found to be 20-30 meters depending on surrounding obstacles. When the Wireless PPG sensor system was used in a Dialysis Clinic for measurement on patients no significant interferences were found to act on the PPG system neither did the PPG system interfere with other medical equipment.

B. The measurements

Fig. 3 shows a six second typical recording using PPG, Portapres and Ultrasound velocity during a hyperventilation exercise of one of the subjects. There was a close resemblance between all three signals. This relationship could be seen in all measurements.

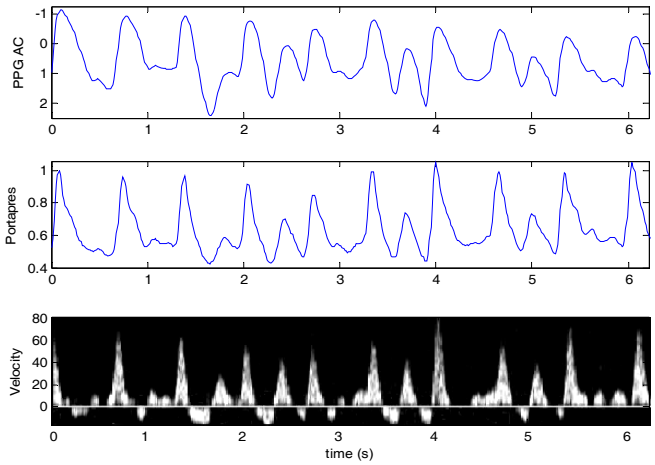

Figure 3. PPG AC, Portapres blood pressure and velocity data recorded in a six second interval during the hyperventilation session. PPG AC and Portapres blood pressure units are in volt (V) and ultrasound velocity in cm/s.

The strongest resemblance in pulse to pulse comparison was found between pulsatile PPG AC, Portapres blood pressure and Doppler ultrasound velocity (Fig. 3) during the hyperventilation session.

The subjects also performed a forced deep respiration. During this period of time, which was close to 30 seconds, a slow variation in PPG AC, PPG DC and the Portapres blood pressure could be seen (Fig. 4). These variations coincide with the respiration monitored by the transthoracic impedance monitoring device (bottom trace in the figure).

IV. Discussion

According to the results presented, PPG AC could follow variations in both Portapres blood pressure and Doppler Ultrasound velocity in pulse to pulse comparison. This relationship was found during all three types of respiration but was most obvious during forced hyperventilation. This may be interpreted as PPG AC attached over the radial artery mostly reflects variations in central blood pressure and blood velocity.

The diameter of the radial artery, also measured by ultrasound Doppler, appeared to be close to constant during all measurements. A constant arterial diameter results in a blood flow which is proportional to the velocity and therefore suggests that the PPG AC signal measured from the radial artery has a strong resemblance with blood flow.

During forced deep respiration the baseline of both PPG DC, Portapres blood pressure and the envelope of PPG AC seems to follow the respiration cycle but with small time delays. Respiration reflected in blood flow variations has different origins on both the venous side [14] and the arterial side [15] and here it is assumed that both are present in the PPG signal.

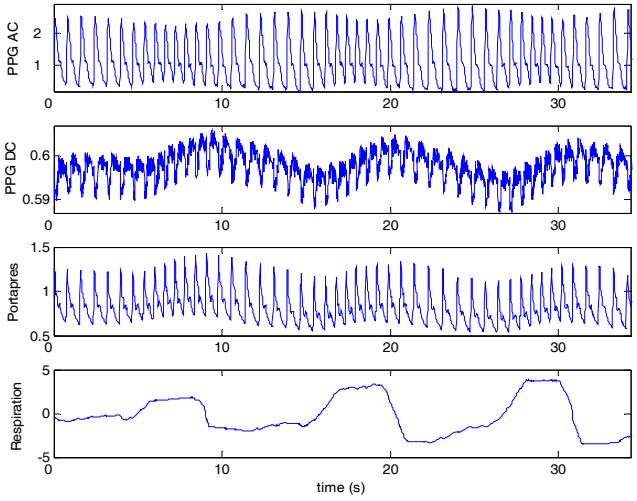

Figure 4. PPG AC, PPG DC, Portapres blood pressure and respiration during a six second forced deep respiration session in one of the subjects. Upward deflection in the transthoracic impedance signal (respiration) represents inspiration. All y-axis units in volt (V).

In conclusion;

- the PPG signal may reflect blood pressure variations as well as a velocity related component in the radial artery
- respiratory events may be observed in the radial artery using PPG
- the wireless PPG sensor system is a new tool for monitoring centrally related physiological parameters but with limited battery lifetime as a drawback

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A Web-Based Data Bank ff Heart Rate and Stroke Volume Recordings During Sleep

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Heart rate variability is widely used in clinical medicine as a diagnostic tool and as a prognostic marker for coronary artery disease. Many of sophisticated heart rate variability analysis methods are used including classic techniques and novel methods based on statistical physics and nonlinear dynamics such as approximate entropy and detrended fluctuation analysis. The need for quantitative evaluation and comparison of analysis methods is evident. It might be solved by the use of new created databases consisting integrity and reliability of raw data from recorded physiological signals which provides facilities for the cooperative analysis of data and the evaluation of proposed new algorithms.

The goal of the study was the development of a public Web-based DataBank of heart rate and stroke volume physiological signals and related data for use by the scientific research community.

DataBank is a large and growing archive of well-characterized digital recordings of physiologic signals of cardiovascular system and related data for use by the biomedical research community. DataBank currently includes 3 following databases: time series of interbeat (RR) interval, time series of stroke volume (SV) values and related data. Additional data include sleep stage coding and personal information of investigated subject. These databases include physiologic signals in each recording that may be freely downloaded. The brief tutorial followed by pointers on downloading data and information about the archives themselves are presented. The lengths of these records vary, but average about 7-8 hours each. DataBank currently occupies about 9 gigabytes and is growing. DataBank currently includes databases of cardiovascular signals and other biomedical data from 50 healthy subjects and 750 patients with a variety of conditions such as coronary heart disease, congestive heart failure, premature beats, atrial fibrillation, sleep apnea, and aging. Apnea - DataBank consists of 274 RR interval recordings, each typically 8 hours long, with accompanying sleep apnea annotations obtained from polysomnographic study of simultaneously recorded respiration signals and is accompanied by a manually-scored hypnogram.

Free electronic access to DataBank via the World Wide Web (http://www.pri.kmu.lt/datbank/) is provided.

Conclusions Developed web-based DataBank offers free access via the web to large collections of recorded physiologic signals for scientific researchers and intend to foster interaction among investigators from many different disciplines; for a broad audience, including basic scientists, mathematicians, engineers, clinicians, and students working in biomedical sciences and related technologies.

Keywords: web-based data bank, heart rate, stroke volume, sleep.

Distance Cardiology and Remote Psychology Care: Is This the Successful Formula?

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Early studies reported the prevalence of psychological disorders and preliminary depression to be 18 to 60 percent in patients with cardiovascular diseases (CVD). Later studies reported relatively consistent prevalence rates of depression in patients with CVD ranging from 16 to 23 percent.

Our aim is to combine the target subjects of two projects for the benefit of both medical staff and patients.

The first project (7- BUL/03/001), co-funded by Bulgaria and International Telecommunication Union (ITU), Switzerland, sought to promote universal access to basic telecommunications and Internet as tools of development in rural areas. Its strategic goal is to develop telecardiology application (monitoring and transmission of ECG, blood pressure and heart rate data) in a rural area in Bulgaria. In addition to telecardiology, a second ongoing project (OHN 1514/2005 funded by National Science Fund, Bulgaria) has started. Its aim is to promote and build up a network for virtual / tele-psychology counseling. The latter is offered to local medical staff and cardiovascular patients in the period 2006-2007.

Key words: Telecardiology, rural areas, depression

I. INTRODUCTION

Lots have been written about the influence of mood, anxiety and psychological disorders on cardiovascular system. The rapid increase of stress factors in contemporary world put the problems of psychology disorders and especially of depression and CVD at the frontline of both medicine and psychology.

Early studies reported the prevalence of psychological disorders and preliminary depression to be 18 to 60 percent in patients with cardiovascular diseases. Later studies reported relatively consistent prevalence rates of depression in patients with CVD ranging from 16 to 23 percent. The most recent review of research on the relationship of depression to CVD [1] found that researchers consistently report major depression prevalence rates in the 15% - 23% range. Prevalence rates can be considerably higher among patients undergoing specific procedures. Studies which report sub-syndromal symptoms of depression [2] have also found higher rates. For example, a study of 200 patients who had recently undergone cardiac catheterization and angiography found that 17% met DSM IV criteria for major depression, and an additional 17% for minor depression [3]. Prevalence rates for major and minor depression among 283 patients who were hospitalized following a heart attack were 18% and 27% respectively [4]. Presumably, additional subjects in these studies suffered from depressive symptoms which, though sub-syndromal, may be clinically significant. Thus the proportion of CVD patients suffering from serious symptoms of depression is in the range 20% - 50%.

Having in mind all mentioned so far plus the facts that:

- Cardiovascular diseases are leading cause of death in Bulgaria;
- The aging of the population and
- The high percentage of elderly citizens have diagnosed CVD

A decision was taken to combine two projects with the firm belief that both patients with CVD and local medical staff will benefit from this step.

II. TARGET AREA AND TELE-CARDIOLOGY EQUIPMENT

The target region is a small semi-mountainous community - Septemvri. The reason to direct attention to a rural area is that 31.6% of Bulgarian population lives in remote villages. If the percent of citizens from small towns is added, more that half of Bulgarians lives in rural areas. People in rural areas are in unfavorable conditions when access to IP-based technologies is considered.

Examination of vital cardiovascular parameters is the first and most often used tool providing clues to cardiovascular problems. Unfortunately, licensed cardiologist is visiting Septemvri Regional medical center once a week for 4 hours. Thus, to receive expert opinion, patients have either to wait or to travel to another region. At first glance the second option may be preferable, but most of CVD patient are chronically ill, unemployed or relatively old and for them such traveling is enormous obstacle. The region is semi-mountainous, which makes travels during autumn, winter and spring rather difficult.

To develop telecardiology service, local medical offices (mainly general practitioners GPs) were equipped with

portable blood pressure meters (holters) and portable 4 channel electrocardiographs (ECG holters).

Blood pressure holters are BOSO TM-2430 PC and are fully automatic, have measurements range 60 - 290 mmHg for the systolic; and 30 - 195 mmHg for diastolic blood pressure; pulse frequency range - from 20 up to 240 beats per minute; measurement intervals - 1 to 30 per hour and memory capacity - over 200 readings. The devices are battery operated. Their weight, batteries included, is 250 g. The software allows saving patients' data and visualizing and/or printing results both in tabular or graphical format. Only a click is necessary to change the format of data presentation.

The ECG holter is product of SIGNACOR Ltd, Bulgaria and is also fully automatic, has 4 MB flash memory, where up to 27 hours ECG records of 4 independent channels may be saved. The holter has a sampling rate 200 s/sec, 50 Hz reject digital filter and weights less than 250 g with batteries and patient cable. Unavoidable self-diagnostic tests for batteries' power and electrodes' impedance are additional bonuses and part of standard monitoring procedure. The software is in Bulgarian, which is an extra benefit and helps GPs partially to overcome the psychological barrier of using new, non-standard equipment. The software allows continuous real-time analyzes of rhythm and morphological changes in all available independent ECG leads; ST measurements; 12 Standard ECG leads reconstruction; automatic marking each time when the ECG differs from the patient's typical ECG; computing every minute averaged heart rate, RR-irregularity, QRS-width and ST deviations; automatic storage of all computed data; statistics of abnormal QRS complexes; measurements of heart rate variability; on-line monitoring on the screen at any time during the recording session; built-in editor to enter remarks and final conclusions; possibility to mark certain ECG episodes and save them as a compressed file; possibility to display and print any ECG episode; generation of summary reports, histograms, tables that may be printed.

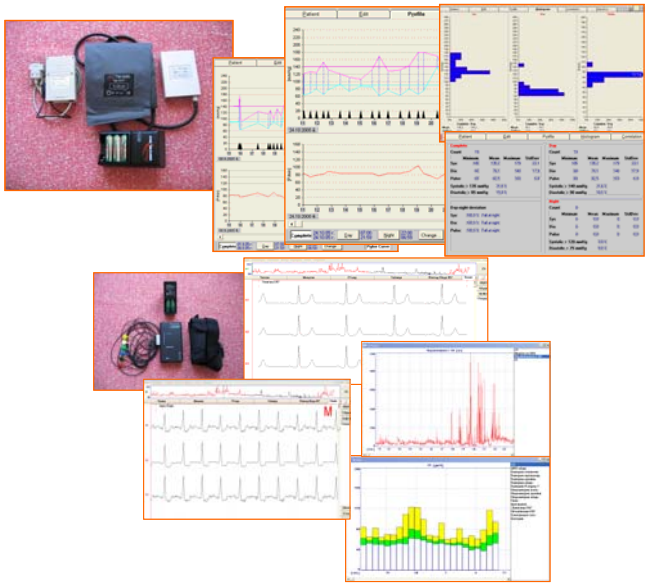

Fig 1 Equipment and data

III. TELE-PSYCHOLOGY

Since the emergence of technology-assisted media such as the computer, Internet and telephone, there has been a considerable shift in the way psychologists provide services to their clients. The terms commonly used are telepsychology or virtual-psychology or even Telehealth. They reflect the nature of remote psychological services. The utilization of information and communication technologies for online counselling and therapy turns out to be one of the most interesting and at the same time rather controversial areas emerging in contemporary psychology. Discussions about application of the net for the needs of psychology began almost 35 years ago with the development of Internet's prototype, the project ARPANET. The later started operation in late 1969 and ended in 1989. Nowadays Internet technologies are widely spread over the world for using different kinds of psychological consulting, therapy and assistance.

The reasons to concentrate on tele-psychology are:

- The means to offer tele-psychology consultations are available.
- In Bulgaria there is a demand of such services. Over 1% of Internet visitors are looking, for psychological information and support. In cities this is done via home computers. In the target region home computers and Internet access from home are rear. Development of local public tele-centres was a solution offering a bigger proportion of population access to virtual psychology consultations.
- In addition, irrespective of its importance, traditionally, psychological help has been treated as the Cinderella of health services. World Health Organization estimates that nowadays almost 1 500 million people suffer from psychological problems and need help. Despite of this fact, psychological consulting, with some exceptions, is not covered by insurance funds. Cyber-psychology offers relatively cheep solution, which may satisfied patients and will not put enormous burden on health care budget.
- As there is one project concentrating on CVD patients, among whom the demand for psychological consultations and support are at a higher level in comparison to other groups of the population, the addition of distance psychology help will (hopefully) increase patients' satisfaction and influence the process of medical treatment.

IV. PROBLEMS

Some of the problems that we faced so far are:

- Personal negative attitude or at least suspicion towards tele-cardiology /e-health applications and especially to distant consultations / treatment as compared to face-to-face service. This has nothing to do with GPs age, irrespective of our preliminary expectations that those GPs that are 45 yrs old and above will be more rigid in accepting new technology.
- Lack of technical experience of both medical staff and patients causes serious problems both in usage of

devices and data collection, analyzes and transfer of records for consultations. Despite of the fact that most of GPs have experience with standard electrocardiographs the use of PC connected devices turned out to be a serious problem. Starting the holters, filling up patients' personal data and medical history and especially downloading results is a serious emotional obstacle for many GPs. This is one serious challenge to be overcome within next months.

- Ethical and financial problems.
- In addition, during virtual consultations people lack the nonverbal communication channel to which they are so accustomed in face-to-face communication. This is partially overcome by application of IP telephones and video connections. Thus in the process of teleconsultations, if and when necessary, colleagues communicate via IP telephones or video channels.
- When tele-psychology counselling is applied, problems caused different kinds of wrong clients' expectations to a consulting psychologist such as;
  - Psychologists are often wrongly accepted as medical doctors. This misunderstanding is usually connected with the notion that a psychologist is someone like a doctor of the human soul;
  - Clients' expectations towards a psychologist often are as if he is a tutor, a supervisor or educator, but it is a wrong kind of attitude. Psychologists in their consulting practice are not supposed to evaluate their clients' abilities, competencies or their personality as a whole. Changing client's behavior or personality by using any kind of reinforcement or punishment ("a carrot or a stick") is also undesirable. A psychologist may give useful psychological information or knowledge for resolving a problem, but it would not be any education.
  - Psychologists experience situations in which they are taken for officials or lawyers. In these cases a psychologist is demanded / required to prepare documents, to make inquiries or something else that is not a psychological work and is away from psychologist's competence.
  - Formally, clients do not take a psychologist for a priest. Nevertheless, there are similarities between these two professional activities that are difficult to be differentiated. For example, people may share their psychological experience or difficulties with a psychologist or a priest. The main difference heir is that a priest sees a man as a sinner, so he is a confessor and is authorized to make remission. Psychologist on the other hand does not accept his clients as sinners and is not authorized to make confession or remission. He is not expected to deal with people's religious feelings and experiences.

V. In Conclusion

The above mentioned problems forced us to re-arrange the time scheme of the projects, to extend the preliminary phase and prolong projects duration.

Nevertheless partners believe that final outcomes will compensate all difficulties as groups that will benefit from the combination of tele-psychology counselling and telecardiology application are not only chronic cardiovascular patients but also patients on medications, which may affect the heart, pregnant women, patients suffering from kidney diseases, pulmonary hypertension, anorexia nervosa, narcolepsy and elderly. The latter group is especially important as congestive heart failure, is the single most frequent cause of hospitalization for people aged 65 years or older and because the percentage of elderly in our population is rapidly increasing.

Acknowledgment

The present studies are conducted and will continue within next years in the context of projects:

1. 7- BUL/03/001 co-funded by Bulgaria and International Telecommunication Union (ITU), Switzerland and
2. Project OHN 1514/2005 funded by National Science Fund, Bulgaria.

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Session 8

E-Health in Developing Countries: The Future of Healthcare

Computer Skills and Digital Divide for HIV/AIDS Doctors in Low Resource Settings

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Abstract-The purpose of this paper is to point out basic informatics knowledge, ability in using computers and access to internet for some of the physicians following courses at the Institute of Tropical Medicine in Antwerp, while working in low resource settings.

I. Introduction

Lack of access to information remains one of the major barriers to evidence based medicine in low resource settings. Limited access to computer facilities, to literature databases and to continuing medical education (CME) programs are just some examples out of the full range causing disparities in universal access to health care information.

Worldwide just 14 percent of the population is online [1] and besides the lack of resources, several other factors as users' skills, time availability, and return of investment are contributing to the information and communications technologies (ICT) gap [2].

In order to decrease the barrier to evidence based medical information the Institute of Tropical Medicine, Antwerp (ITMA) supports physicians working in low resource settings on HIV/AIDS care with a telemedicine service (http://telemedicine.itg.be) [3].

Figure 1 ITMA Telemedicine website

The physicians can send difficult clinical cases and questions to a web-based discussion forum (Fig.1). A network of HIV/AIDS specialists is responsible for their discussion and the formulation of a final advice. Clinical images and bibliographic material are used to accompany questions and answers. Interesting cases and recurring questions are elaborated as case rounds and frequently asked questions (FAQs), consultable through the search function for CME on the website. User-friendly guidelines, links, digested conferences coverage and news always targeting low resource settings are also available for consultation.

This telemedicine service is directly linked with a Short Course on Antiretroviral Treatment (SCART), see Tab. 1.

TABLE 1
Short Course on Antiretroviral Therapy (SCART) content

At the end of this training physicians should be able to:
- Choose, and explain to the HIV positive patient, the appropriate antiretroviral drugs taking into account the goal of the therapy, the optimal timing for initiation of treatment, and the general characteristics of the patient and the availability of resources in a specific setting.
- Plan a monitoring strategy for a patient on ART including clinical follow up, adherence monitoring, laboratory follow up, identification and management of immune reconstitution inflammatory syndrome and side effects.
- Identify and predict ART failure, to be able to assure the management of it, including the prescription of the appropriate alternative ART taking into account the available resources
- Evaluate the quality of care for patients with chronic health problems like AIDS patients and relate quality aspects to the organization of a clinic taking into account the different resources needed for AIDS care.
- Explain the possible impact ART can have on mortality and the role of clinical care within the whole spectrum of interventions addressing the health and social care challenges related to the HIV epidemic.

During this 3 week summer course on HIV /AIDS care and use of antiretroviral therapy (ART), participants receive an initiation on how to use the telemedicine service.

II. METHOD

At the end of the SCART in 2004 and 2005 we assessed the trained physicians' access to the World Wide Web (WWW) and their abilities/attitudes in using computers while working in the field.

The questionnaire has been prepared using SmartLite WebQuiz Software, and it has been accessible online during the SCART training through the Telemedicine website.

The questionnaire measured different variables as physicians' accessibility to the WWW, eligible hours for connection, computer characteristics, clinicians' ICT skills, and use of operating systems.

The data were automatically analyzed using SmartLite Software Web Administrator Interface, which allows reviewing questions and answers given by users, total scores, and statistics: all results are saved automatically to a Microsoft Access database, which can also be exported to Microsoft Word, Microsoft Excel or simple text files.

III. RESULTS

Out of the total of 84 trained physicians, who were mainly African and Asian nationals working for international organizations or for the ministry of health, 75 completed the questionnaires.

While 11 % (N=8) of the physicians stated not to have access to the WWW, almost all of them mentioned to have an own e-mail account (N=74).

Of the interviewees, 69% (N=52) preferred to access the internet in the evening hours (5-12 PM) (Fig. 3). A connection speed of at least 28.8 kbps was available to 40 % (N=30) of the audience.

For 83% (N=62) the operating system in use was Windows 2000/XP, 93 % (N=70) had a CD reader, and only 63 % (N=47) had a sound card on his/her computers (Fig. 3).

Two third of the users reported to be able to download files and to use software such as Acrobat, Excel, PowerPoint, WinZip, and Word (Fig. 4).

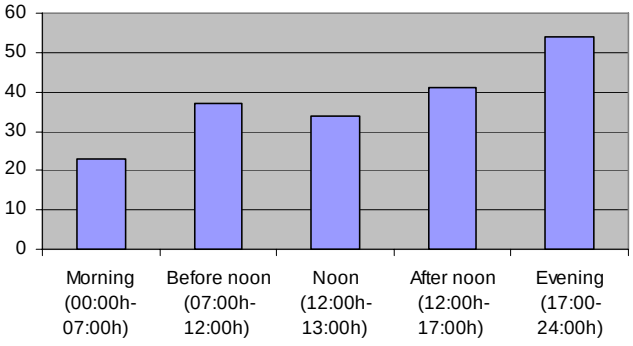

Figure 2 Preferred time to access Internet

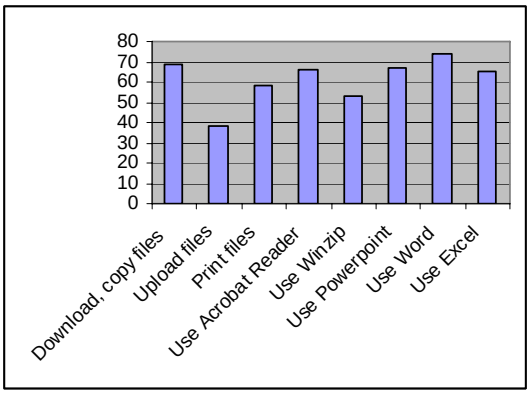

Figure 3 "Are you able to ... ? "

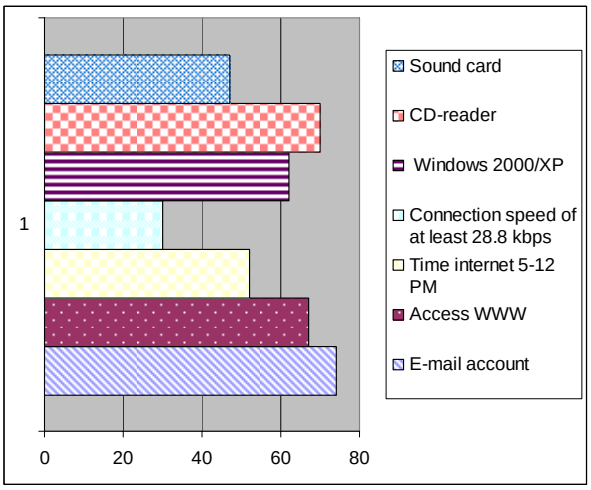

Figure 4 Access to WWW, e-mail, computer characteristics

IV. CONCLUSIONS

Although the WWW access, ICT ability and use remain limited in low resource settings, our selected group of physicians working in the field of HIV/AIDS, showed a good level of basic informatics knowledge, ability in using computers and access to internet.

This type of online tools creates opportunities for CME and support in the management of difficult HIV/AIDS cases for colleagues working in low resource settings.

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eHealth Program in Georgia

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Abstract-The advent of modern communication technology has unleashed a new wave of opportunities and threats to the delivery of healthcare services. eHealth, a broad umbrella term for delivery of medical care at a distance, has reached around the world, and now healthcare professionals can communicate faster, more widely, and more directly with patients and colleagues, no matter where they are. eHealth may in fact have a more profound impact on developing countries than on developed ones.

I. INTRODUCTION

The state of health of a population is a direct determinant of development. It affects productivity, the potential of children, infant and general mortality, and the allocation of resources within a family, community and nation. Access to better healthcare services redounds to poverty reduction and increased productivity. Investment in healthcare is a prerequisite to economic and social progress [1].

Population growth and the emergence of new health problems are increasing the demand for healthcare services and for more expensive treatments. Increasing demand, slow economic growth and rising healthcare costs have not been in parallel with the funding of the healthcare sector in most developing countries. Healthcare infrastructure, buildings and equipment, medical staff, drugs, vehicles, is central to good healthcare requiring high investments. Healthcare services must also be integrated, cost-effective and available to the people who need them. The adoption of sound policies and strategic plans that will guarantee the provision of quality, sustained and integrated healthcare services to its population are challenges faced by most governments of the developing countries today. To meet this challenge, governments and private healthcare providers must make use of existing resources and the benefits of modern technology.

Many developing countries have inadequate healthcare and medical services. Developing countries suffer from a shortage of doctors and other healthcare professionals. The inadequate infrastructures of telecommunications, roads and transport make it even more difficult to provide healthcare in remote and rural areas and to transport patients properly [2]. Where clinics and hospitals exist, they are often ill-equipped and, especially, outside urban areas beyond the reach of normal communications.

Developing countries face various problems in the provision of medical service and healthcare, including funds, expertise, resources, which relate to the lack of facilities and systems.

For countries with limited medical expertise and resources, telecommunications has the potential to provide a solution to some of these problems. Telemedicine services have the potential to improve both the quality of and access to healthcare regardless of geography. They enable medical and healthcare expertise to be accessed by under-served locations. Healthcare professionals can be more efficient. Telemedicine offers solutions for emergency medical assistance, long distance consultation, administration and logistics, supervision and quality assurance and education and training for healthcare professionals and providers. Telemedicine can help in combating infectious diseases and meeting the particular requirements of dermatology, traumatology and the many other medical specialities.

In the developed countries, there has been a rapidly growing interest in telemedicine and eHealth as means to ease the pressure of healthcare on national budgets. Some of the technologies and experiences of the developed countries could help developing countries in their desire to provide, especially, primary healthcare.

Telemedicine and eHealth have many socio-economic benefits; they can generate new sources of revenues for service providers and equipment suppliers and can optimize the use of available human and capital resources in developing countries. But these fields need to be implemented carefully and managed well. The impact of telemedicine on healthcare structures can be significant. In this respect, eHealth can be seen as a tool to reorganize or to build up new healthcare structures. It also raises concerns about liability, confidentiality, competition and other policy and regulatory issues.

II. SCOPE OF EHEALTH

This article focuses on the possibilities of eHealth in Georgia. The present part surveys telemedicine experience around the world, different telemedicine applications and the technologies for diffusion of telemedicine.

The telemedicine industry appears to be growing rapidly, judging by the growing number of conferences on the subject

and World Wide Web sites dealing with telemedicine services, but there are, as yet, few examples of commercial profitable services. The developed countries of North America, Europe, Japan and Australia have considerable experience in telemedicine and eHealth. In Europe, the European Commission (EC) has supported a large number of telemedicine/eHealth projects. The EC has its telemedicine/eHealth programme squarely aimed at developing a competitive European telemedicine industry as well as improving the delivery of healthcare services to Europeans.

There are many telemedicine and eHealth applications, some with very sophisticated and expensive technologies. Telemedicine applications using virtual reality technologies are being developed and demonstrated in the United States and United Kingdom. Such sophisticated and expensive technology is out of the reach of developing countries. What they need is low cost, sustainable solutions to the delivery of medical and healthcare as well as access to appropriate expertise, especially in the event of emergencies.

Although telemedicine and eHealth have many socio-economic benefits, they can generate new sources of revenues for service providers and equipment suppliers and can optimize the use of available human and capital resources in developing countries, it is important to recognize, that investing in a telemedicine and eHealth delivery system will cost something and that something will be competing for scarce resources in developing countries. External support and funding, i.e., outside the developing countries, can be contemplated, but the sustainability of the delivery system, of the value chain, should be scrutinized carefully before committing significant capital.

The success of a telemedicine service will depend heavily on which technologies and services are used, on how appropriate they are to particular countries, recognizing that the situation may differ from country to country. Or, to put it another way, what may work in one country may not meet the needs of another country.

III. EHEALTH PROJECTS IN GEORGIA

In Georgia there were implemented two International Telecommunication Union (ITU) supported telemedicine projects. The first one was started in September 1998 and involved the connection of the Institute of Radiology in Tbilisi to the Diagnostic Imaging Centre in Lausanne, Switzerland via the Internet in order to acquire medical second opinions. In the frames of this project Vidar VXR-12-Plus was used for CT and MRI images digitization.

The second telemedicine project – Telecardiology, it has implemented the simple method of ECG transfer using ordinary telephone receiver. It was partly funded with excess revenues generated by the ITU Telecom exhibitions. Project enabled a trans-telephonic electrocardiogram for diagnostic and emergency services. The project was one of several others which were implemented in selected developing countries as part of the ITU's strategy to use information technology for the aim to help healthcare professionals solve some of the most acute healthcare issues in developing as well as emerging economies, according to Recommendation Nine of the Valetta Action Plan adopted by the ITU in 1998. Partners in the project include the Tbilisi Cardiac Clinic GULI, Telecommunication Company of Georgia and the Telemedicine Foundation of Russia.

But in Georgia there were implemented other telemedicine projects too. In 1996 and 1997 National Association of Cancer Control established e-mail communication and conducted teleradiological and telemorphological conferences through financial support of Open Society Georgia Foundation. Particularly, X-ray grams, histograms and cancer incidence database were transferred from Batumi (Adjara region) to Tbilisi National Cancer Center by e-mail.

Heart and Vascular Clinic uses Agfa Deluxe Slide Scanner for teleradiology. The center also transfers phonocardiograms, ECG and Video .avi files to medical centers in Germany and US for second opinion gathering.

Emergency Cardiology Center and National Information Learning Center are implementing telecoronography (telecardiology/teleradiology) – transfer of X-ray images for second opinion to German and Turkish colleagues (by usage the both HP Scanjet and Apple 1 scanner as well as Olympus Camedia D-620L high resolution digital camera).

Center of Disaster and Emergency Medicine has developed software and tested TelCoNet – Teleconsultation network project for emergency medicine [3].

At 2004 in Georgia was established non governmental organization Georgian Telemedicine Union (Association), which organizes remote consultations and educational sessions in different medical fields. Remote consultations are implementing as in static (through consultational servers and e-mail) so in dynamic (teleconferencing) modes. At 2005 Georgian Telemedicine Union (Association) starts implementation of NATO Networking Infrastructure Project "Virtual Health Care Knowledge Center in Georgia", which aims creation of telemedicine consultation server, organization of eLearning courses and also set-up of telemedicine unit in Kutaisi (West Georgia). Georgian Telemedicine Union (Association) is also implementing Black Sea Economic Cooperation (BSEC) project "A System to Fight HIV/AIDS, Tuberculosis and Malaria in BSEC Countries with a Help of Info-Communication Technologies" in collaboration with Russia and Ukraine.

IV. EHEALTH PROGRAMME

Unfortunately, the hard social-economic situation in Georgia and unenviable inheritance has an effect upon today's status of healthcare in the country. The lack of the newest information is obvious; this has negative effect upon the level of qualification and effectiveness of medical care in the most cases. Due to the geographic features of the country there are some remote regions (Svaneti, Meskhet-Javakheti, rural areas of Adjara) in Georgia, the population of which is out of skilled medical care by different reasons. Systematic monitoring and identification of widespread of infectious diseases and especially of HIV/AIDS, hepatitis, tuberculosis, diseases of unknown etiology in the country are not carrying out. The implementation of wide scale early screening

programs which will be accessible for the large groups of population is impossible under conditions of low range financing of healthcare. The endemic diseases (i.e. goiter stipulated by the deficiency of iodine) are difficult and specific problem. On the background of the hard social-economic situation the government could not ensure the population with free and/or low-price basic medical services. The improvement and adjustment of hospitals and clinics' technical possibilities is impossible without outside financial support. Regional medical institutions and centers are the least and poorly equipped. As a result regional population prefer obtain medical service in capital. Unfortunately, healthcare is centralized in Georgia.

But despite of rather hard situation in healthcare Georgia is technologically prepared for the introduction of telemedicine. In particular, distributive infrastructure of computers, Internet providers and their possibilities are quite well developed in the country and their today's status is absolutely enough for telemedicine. The optic-fiber magistral (STM-4 and STM-6 systems of SDH generation) in Georgia includes different interurban directions. Three international directions are implemented: 1) Tbilisi-Poti-Novorosiisk (Russia, NIS, Europe, other world); 2) Tbilisi-Armenia; 3) Tbilisi-Azerbaijan (Iran, the south route of Trans-Asia-Europe "TAE" magistral, Asia). The services of Georgian Internet providers include: dial-up, leased line and DSL. Since 2004 the wireless communication is implementing (Point to Point and Point to multipoint connections in 5.7 GHz Frequency range with TDD/TDMA Half/Full Duplex RJ45 Auto Detect 10/100 BaseT Interface). At 2005 the communication route Axaltsikhe-Borjomi-Khashuri-Tbilisi (DeltaCom-Sagem Project) was established. Two GSM operators – Geocell and Magticom, are acting in Georgia. Both of them have GPRS service. In the country there are used decade-step automatic phone stations, coordinate automatic phone stations, electron automatic phone stations and digital automatic phone stations.

Therefore, Georgia is characterized by the limited medical expertise and resources, but well-developed telecommunication possibilities. As a result telecommunications have the potential to provide a solution; particularly they serve as the good and reliable background for the introduction of telemedicine. It should be mentioned, that eHealth has the potential to improve as the quality so the accessibility of medical service in the country. But this modern field of medicine should be implemented carefully and managed well because of its obvious and significant impact upon healthcare.

It is reality, that there are some telemedicine applications with very expensive and sophisticated technologies. They are well-used in the most of developed countries, but out of reach of developing countries. For the purpose of effective and adequate introduction and implementation of telemedicine such countries as Georgia need low cost and sustainable solutions, which can be easily adopt with the existing hardware. Therefore, the success of telemedicine will depend upon the choice of hardware and software and its appropriateness to the country. Undoubtedly, the partnership with the foreign colleagues has decisive role at each step of telemedicine introduction and development in Georgia. It should be especially noted, that telemedicine is the most important for the ensuring the safe primary medical care in the country. The first contact of patients needing medical help is the contact with the local primary healthcare center. Second opinions from specialists are often required in primary healthcare centers (i.e.: radiology, cardiology, dermatology, consultations with specialists regarding further treatment of the patient; is hospitalization needed or not? etc.).

In accordance with the strategic recommendations about eHealth development and on the background of practical experience Georgian Telemedicine Union (Association) worked out the concept "eHealth Program". It defines the priorities and aims of eHealth network creation in the country. The implementation of this concept will ensure the increasing of medical service level and its accessibility to population. In its frames development of existing telemedical centers, creation of new ones and as a result establishment of network is planned. Distance medical consultations and trainings are the integral and key activities of program implementation.

"eHealth Program" is an adequate tool to provide specialized knowledge to remote places. By using of telecommunication technologies the experience of medical consultants can be transported to the patient; the patient will be transported to medical centers only in situations in which specialized treatments are required, which are not available in peripheral healthcare centers. An efficient and appropriate strategy of medical care can be worked out at the initial steps of patient's contact with healthcare. Such an approach can avoid unnecessary hospitalization and will be a substantial contribution to the reduction of health costs.

The "eHealth Program" will ensure the common medical-communication space in the country, the approach which can be effectively used for Georgia territorial unity restoration.

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Telemedicine as A New Tool in Emergency Medical System of Uzbekistan

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Aim. The purpose of this paper is to study current situation, existing problems and the ways of problems solving in development of telemedicine in main referral hospital – Republican Research Center of Emergency Medicine (RRCEM) as one of the telehealth model on the territory of former Soviet Union country.

Material and methods. The main decrees of the President of Uzbekistan and the Cabinet of Ministers of Uzbekistan related to development of informational technologies in the country and especially the situation in telehealth's technologies implementation in emergency medical system of Uzbekistan were analyzed and compared with reality of decrees' and orders execution. Also, activities of international organizations by introduction of telemedicine in emergency medicine of Uzbekistan were studied and evaluated. To determine the level of computer skills of medical personnel of RRCEM special survey from March 2005 has been conducting and first results obtained. The budget of the hospital for informational technologies development, for sustainability of existing computers with internal net system and budget allocation for implementation of electronic medical recording system has been reviewed.

Results. Approved decrees of the Government of Uzbekistan by implementation and development of informational technologies including telemedicine were appropriate and necessary. Inputs of international organization in telehealth/telemedicine development were sufficient but sustainability has not been foreseen. Due to problems with exact determination of financing resources for telemedicine development slow evolution of informational technologies in health care system has been felt. There are not an appropriate number of medical personnel in RRCEM who do not have elementary computer skills, which also impedes use of electronic communication and telemedical consultation.

Conclusion. State controlling mechanism of decrees by informational technologies development execution and clear resource allocation for this purpose should be determined. Training programs for liquidation of computer illiteracy should be immediately implemented in the RRCEM and in whole emergency medical system of Uzbekistan, which could help to develop teleconsultations between affiliates of the RRCEM throughout of the country and main referral hospital located in the capital even using insufficient amount of computers, instable internet and intranet connections.

Keywords: Uzbekistan, Emergency, Telemedicine, education;

Role of Telemedicine in Delivering Healthcare in Remote Areas of a Developing Country

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Abstract-Telemedicine, as the name implies, is medicine delivered across a distance.

It essentially means that the patient and the healthcare provider are separated physically. In Telemedicine, the information moves, rather than the doctor or the patient. The information may include medical images, live two-way audio and video, patient medical records, output data from medical devices and sound files.

Telemedicine is a revolutionary concept in health care as it saves lives by providing timely healthcare, reduces both the geographical limitations and the cost of treatment along with improving the quality of medical care.

As Telemedicine is all about patients and their benefit, the applications should always be need driven as opposed to technology driven. With this premise, Pakistan's first Hub & Spoke/s model of Telemedicine is established in the province of Sindh connecting 2 primary/secondary care hospitals in the rural areas to a tertiary care center in Karachi. With a population of more than 145 million people Pakistan only has around 13000 specialists in all fields and around 110000 registered doctors. This scenario is compounded with the fact that the above number of doctors and specialists are not evenly distributed in the country but are saturated in 3 – 5 major cities. With the limited human and financial resources. The only solution to the exorbitant need for healthcare to the rural areas of Pakistan can be provided by Telemedicine

The basic method is store & forward Teleconsultation but real time videoconferencing is also available for selected patients.

The special Telemedicine applications in this model include Teledermatology, Telecardiology and Telemedicine for all major diseases covered in internal medicine

The model also includes distance learning module for doctors present in the remote hospitals.

I. INTRODUCTION

Health care policy in most developing countries has emphasized the development of government-owned health services, largely financed by government tax revenues. Over most of the period in the last couple of decades, attention has focussed on how to plan and develop these public investments. Following the recommendations of international agencies, such as the World Health Organization, many countries have established similar systems of peripheral clinics and health workers, integrated community health centers, and a tiered system of public hospitals. As such systems became established, there was increasing attention given to how to obtain greater health impact from this service capacity. This concern gave rise to new strategies for health care resource allocation, such as the primary health care approach, the child survival and development revolution.

II. PUBLIC HEALTH INFRASTRUCTURE OF PAKISTAN

The public health infrastructure in Pakistan has failed to deliver over the last 50 years since its creation in 1947. The failure has been due to a lack of commitment from all the governments, poor distribution of Health care professionals, poor availability of facilities in the peripheral parts of the country including the densely populated Rural areas of the country which make up more than half the population on the country. The absolute lack of health managers, and the ignorance of the authorities to obtain the help of IT in the upgrading of the facilities is another reason why the structure which promised so much has failed so badly.

The health expenditure indicators [2] such as the GDP per capita and the total expenditure on health shows the apathy of the health authorities which can be seen in the chart below.

Health Expenditure indicators [a]

		Y
GDP per capita	495	2002
Total expenditure on health (per capita)	15	2002
General government expenditure on health (per capita)	4	2002
Total expenditure on health of % of GDP	3	2002
General government expenditure on health as % of total health expenditure	28.5	2002
Out-of-pocket expenditure as % of total health	56.7	2002

expenditure		
Ministry of health budget as % of government budget	3.5	1999

The health budget and the total expenditure on health of the GDP is definitely a lot less than expected for a population so reliant on the Public Health care system.

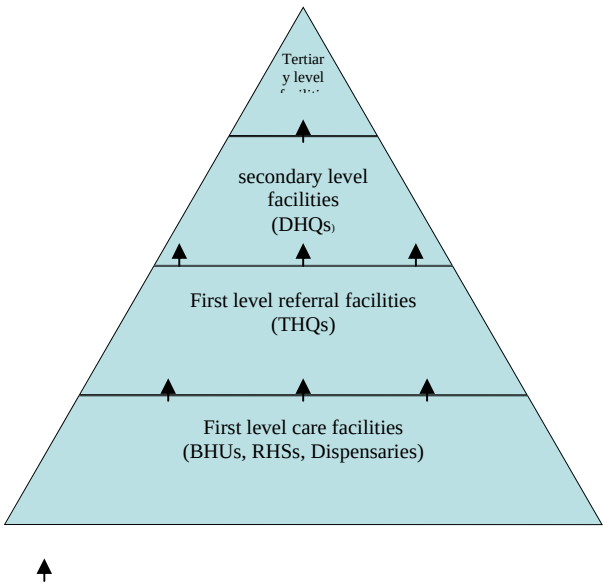
III. HEALTH CARE POLICY OF PAKISTAN

The Population of Pakistan is approximately – 149.5 million, growing at 2.06 percent per annum 48 million people live below the poverty line. 45 % of the Population is without access to Health services. 60% of the burden of disease (BOD) is because of poverty related communicable diseases, childhood illnesses, reproductive health problems and malnutrition. 50 women die each day from pregnancy, childbirth and abortion. Only 18% births are attended by trained health personnel.

In Pakistan, Private Medical care is also present in both urban and semi-urban areas. It enjoys a significantly higher reputation and utilization than the Public services can offer. Keeping the limitations of the public sector in mind, we may be made to believe that referral[1] in the public health care delivery system of Pakistan does not work. Major deficiencies relate to its poor management by health care providers and its intentional bypassing by consumers. Poor quality of clinical and support services provided by this service may be the single most important underlying reason for the latter; insufficient preparation and training of facility managers and their teams, for the former. These suppositions are supported by the exceedingly low service utilization rates as well as the deplorable state of relevant records and doubtful diagnoses generally observed throughout all levels of care

IV. HUMAN AND PHYSICAL RESOURCES

The public health infrastructure [1] in Pakistan can be explained with the help of the figure given below.



V. IDENTIFIED PROBLEMS

Pakistan's health system [3] is crippled by chronic underinvestment, both in facilities and staff. Although Pakistan produces doctors at an alarmingly high and unregulated rate, most look towards the lucrative private sector; finding health professionals, especially women, to work in rural areas is difficult.

Major issues identified in the compromised existing healthcare deliver model:

- Inadequate and inferior quality healthcare services due to lack of financial and resource commitment from the government
- Saturation of healthcare professionals in urban areas leaving the majority of population without the availability of adequate and timely healthcare services.

Following are the general lacks identified in the public healthcare system:

- Inadequate budgetary allocation by the government
- High population growth rate
- High fertility rate
- Focus on curative medicine than the preventive treatment
- Poor primary health care services
- Lack of integration of vertical Preventive programs
- Inadequate social sector services delivery
- Professional and managerial deficiencies Ill trained health professionals
- High prevalence of communicable diseases
- Lack of integrated management of childhood illnesses
- Malnutrition
- Low skilled birth attendance rate
- Double disease burden
- High Infant mortality
- Uneven distribution of healthcare professionals being saturated in the urban population
- Absence of patient records at any level

VI. FIRST TELEMEDICINE PROJECT OF SINDH

A typical Hub and Spoke, Store & Forward and Real Time Teleconsultation project, was launched in April, 2005 between Jinnah Postgraduate Medical Center, a tertiary care center in Karachi and Civil Hospital Shikarpur and Taaulluka Hospital, 2 secondary care centers, at Shikarpur and Gambat, respectively located in the rural areas of the province of Sindh. All the three hospitals are owned by the government and the patients do not pay any fee for service or treatment. The Teleconsultation, therefore, was also totally free for every patient.

The scope of the project was to provide primary diagnosis and second opinion to the patients who present at the spokes in specialties such as neurology, dermatology, neurosurgery,

pediatrics, gynecology, general medicine and general surgery.

A special electronic medical record software was used to store and transfer the patient information including demographic & clinical information, dermatology & radiology images and heart sounds and ECG.

Medical Peripherals including electronic stethoscope, electronic ECG, digital camera and a digital scanner were used to acquire patient information and incorporate into the electronic medical record software

Videoconferencing was done through professional videoconferencing cameras over 384 kbps bandwidth using 3 ISDN lines at each center.

Three different methods of Teleconsultation were used including store & forward session only, store & forward coupled with videoconferencing session and videoconferencing only without transfer of patient information through the electronic medical record software.

VII. OUTCOME OF THE TELEMEDICINE PROJECT

This Telemedicine project categorically provided the solution to the 2 major issues identified in the healthcare services model of a developing country like Pakistan by:

- *Bridging the physical gap between the appropriately trained healthcare providers and patients through the use of information technology*
- By educating the physicians in the spokes of the remote areas raising their level of competence allowing them to provide healthcare services at a better level than before.

VIII. BENEFITS OF THE TELEMEDICINE PROJECT:

- Through this Telemedicine network, quality and relevant treatment in a timely manner was given to patients without displacing them from their own cities.
- Patients who presented at the spokes received treatment for nearly all specialized fields of medicine and surgery without having to travel.
- The patients had access to the services of trained specialists of the respective fields of medicine and surgery who treated them through the latest protocols in place.
- The local physicians at the Spokes received direct teaching and training in respective fields of medicine and surgery from the specialists at the Hub
- Patient information became documented and accessible for all concerned whenever it was required for follow up treatment or change in treatment plan
- Patients' compliance improved and the outcome of treatment enhanced accordingly.
- Cost of treatment was significantly reduced since there was no traveling involved and the patients received the right medicines and underwent only the relevant investigations due to availability of a specialist opinion from the Hub.
- The process of physical referral to the tertiary care center, if and whenever required, significantly improved for those patients who were initially presented through the Telemedicine network.
- This project became a positive precedence to be replicated in other provinces and rural areas.

IX. CONCLUSION

After one year of successfully running the First Telemedicine project of Sindh, it is concluded that Telemedicine offers significant, cost effective and high quality value addition to the compromised healthcare services model in a developing country like Pakistan. Therefore, another four spokes are being added to the existing network expanding it to a six spokes model of Telemedicine

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E-Health as a Tool to Improve Access to Health-Care Services in Developing Countries

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This presentation has been prepared on the basis of several reports made as results of study on Telemedicine for the needs of developing countries in the Study Group 2 of the Telecommunication Development Sector of the International Telecommunication Union and the Resolution 41 on "eHealth" by the World Telecommunication Development Conference which took place in March 2002 in Istanbul, Turkey.

It is believed that success of the introduction of eHealth solutions and services depends very much on how the telecommunication authorities from developing countries can establish the mutual beneficial cooperation with health care authorities in their respected countries and offer to them the full potential of modern information and communication technologies (ICT) to improve access to and even quality of health care.

It is important to develop strategies to guide the international utilization of ICT in the global health care environment for the benefit of all.

Conference has recommended that the BDT has to study the potential of telemedicine to meet some of the needs of developing countries in the improvement of access to the health care services. The past several years have witnessed an explosive growth of the "informatization" of support to health care, especially in the industrially developed countries. In many cases these projects deal with Hospital Information Systems (HIS) and teleradiology with particular emphasis on PACS (Picture Archiving Communication Systems).

The working method of any Study Group in the ITU is to study a Question by a team of volunteers from different countries - Member States. Therefore the ITU Study Group is able to present a worldwide experience and to share the information on best practice among countries. The ITU telemedicine group is unique in the world dealing with the needs of developing countries and it consists with experts from developed and developing countries.

I. INTRODUCTION

For the first time the question about telemedicine was risen in March 1994 in Buenos Aires where the Telecommunication Development Bureau (BDT) of the International Telecommunication Union (ITU) convened the World Telecommunication Development Conference. The Conference has recommended that the BDT has to study the potential of telemedicine to meet some of the needs of developing countries in the improvement of access to the health care services. The past several years have witnessed an explosive growth of the "informatization" of support to health care, especially in the industrially developed countries. In many cases these projects deal with Hospital Information Systems (HIS) and teleradiology with particular emphasis on PACS (Picture Archiving Communication Systems).

The Conference approved a Question 6 (in 1998 it was renumbered into Question 14) on telemedicine which was assigned to the Study Group 2 of the ITU Development Sector, as well as Recommendation No.1 on Application of Telecommunications to Health and other Social Services. The Conference noted that "…the widespread use of telemedicine services could allow universal health access and consequently facilitate the solution of the principal health problems connected with infectious diseases, pediatrics, cardiology, etc., particularly in areas where medical structures are inadequate or non-existing." Even in the area of health information there is still a great unmet demand.

The working method of any Study Group in the ITU is to study a Question by a team of volunteers from different countries - Member States. Therefore the ITU Study Group is able to present a worldwide experience and to share the information on best practice among countries. The ITU telemedicine group is unique in the world dealing with the needs of developing countries and it consists with experts from developed and developing countries.

Studies conducted by the Rapporteur's Group and reports published together with the discussions and recommendations of the African Regional Telecommunication Development Conference (Abidjan, 1996), the Regional Telecommunication Development Conference for the Arab States (Beirut, 1997) and two the World Telemedicine Symposium for Developing Countries (Lisbon, 1997, Buenos Aires, 1998), as well as reports on the missions to developing countries by telemedicine experts, all show that developing countries have an overwhelming need for the provision of

medical and health care services, especially in areas outside the cities and that eHealth/telemedicine services could be an economic means of achieving national health policy objectives with regard to improvement and/or extension of medical and health care, especially to non-urban and remote areas.

The latest World Telecommunication Development Conference which took place in March 2002 in Istanbul, Turkey, approved the Resolution 41 on "eHealth (including teleheath/telemedicine)". This Resolution is the background document for the development of eHealth policy.

II. WHY EHEALTH IS BENEFICIAL?

eHealth or telemedicine is no longer a technology awaiting applications. This is a power tool which has been in many pilot cases successfully implemented in several countries. And despite the growth of ICT equipment and tools in health sector, their impact depends largely on whether or not they are used, and how, when and where they are used, which in turn are greatly influenced by the organization of provider systems and the behavior of care givers.

The WHO has recently prepared a very important document on "Towards a World Health Organization eHealth Strategy" which was presented and discussed at WHO General Assembly in May 2005.The WHO is also going to make a comprehensive evaluation of already introduced eHealth services in developing countries in order to prepare the recommendation dealing with medical aspects of eHealth for health care professionals.

If the decision-makers in the health sector wish to take into account eHealth services within the framework of the national health policy, they should consider at least four aspects of health-care where eHealth could play a role:

(a) Quality and efficiency of health care services;
(b) Health education for both medical staff and citizens;
(c) Reinforcing national health structures;
(d) Administrative.

To improve access to medical knowledge, to provide the consultation remotely to small hospitals located in rural areas, to reduce the unnecessary transfer of patients to regional hospitals and provide the right treatment on the spot under supervision at a distance, this is a few applications of eHealth relevant to developing countries.

The special attention has to be paid to the opportunities offering today by intelligent medical diagnostic systems operating as a rule in different languages. They will play the important role for medical staff in rural and remote hospitals to improve the quality of care and, of course, these systems will save physician time everywhere. The systems are interactive and highly scaleable allowing the medical professional to validate results, record prescriptions and monitor and evaluate outcomes.

eEducation in health is also one of the most significant uses cited for multimedia technology in healthcare. The most common or general application in eEducation would be the delivery of a lecture at any location by a health expert which is then made available over the Internet, to any number of students sharing a common workstation or scattered over a campus, a city or the world. There are today a growing number of Web sites that offer virtual education in health and health-related areas.

Distance learning through telecommunication tools can bring critical knowledge to the participants, particularly to information-poor hospitals and medical schools in developing countries. The course material has to be redesigned for online use and the professors be trained in lecturing online.

Since eHealth relies heavily on Internet technologies, it is necessary to promote e-literacy. Consumer need to learn not only how to navigate the World Wide Web, but also how to critically evaluate the reliability, accuracy and the source of information, and services offered online.

Effective governance of eHealth requires codes, regulations, and standards to ensure satisfactions of the consumers. Issues in governance include legal liability, ethical standards, privacy protection, and cultural and social standards. Medical culture and practice can and do vary greatly from country to country and this has also be taken into consideration.

Today medical professionals who are unfamiliar with (or have limited access to) ICT and existing decision support and communication tools relevant to healthcare cannot function effectively either in private or public hospitals. They are unlikely to take full advantage of technology that is available to them or contribute innovative ideas for applying information infrastructure to population health.

III. PILOT PROJECTS IN DEVELOPING COUNTRIES

In accordance with the decisions of the World Telecommunication Development Conferences, the Telecommunication Development Bureau (BDT) of the International Telecommunication Union has undertaken various activities related to the study of the potential benefit of eHealth applications in the health care sector of developing countries as well as the demonstration of these applications in implemented eHealth/telemedicine pilot projects in selected countries.

During the period 1996-2000, BDT/ITU organized several expert' missions to developing countries in order to identify their needs and priorities for the introduction of eHealth services taking into account the state-of-the-art of the local telecommunication networks and their evolution. The following countries were visited: Mozambique (1996), Uganda (1996), Cameroon (1996), Tanzania (1996), Bhutan (1997), Viet Nam (1997), Mongolia (1998), Senegal (1998), Georgia (1998), Uzbekistan (2000), Ethiopia (2000). The results of these mission were discussed at meeting of ITU/BDT telemedicine group and included in the final report of the study.

The first ITU telemedicine project was implemented in Mozambique. Two central hospital, one in Maputo, the capital, and the second in Beira, one thousand kilometers away from Maputo, were connected by a telemedicine link using the existing telecommunication infrastructure. Terrestrial and satellite links were used. At that time it was only five doctor-radiologists for the whole country and they were working in Maputo. For each difficult case the X-ray

film has to be sent to Maputo for consultation. It was not easy and time consuming. With the introduction of teleradiology link, the X-ray image from Beira is transmitted to Maputo electronically. This link was a dual purpose one for teleradiology and second for teleconsulting.

On 30 January 1998, the Prime Minister of Mozambique, Mr. Pascoal Mocumbi, inaugurated the country's first telemedicine link. "Telemedicine will end the isolation which has, until now, existed between professionals in the country", the Prime Minister told participants who witnessed the historical launch of the one of Africa's first pilot projects in telemedicine. "I urge all participants in this project, in particular the Empresa Nacional de Telecomunicacoes de Mozambique, to continue their effort in finding innovative applications to telecommunications for the benefit of the entire society", he added. A few years later, the telemedicine link was extended to Namula, Mozambique's third largest city.

Then the BDT/ITU implemented several small pilot eHealth projects in the following countries: Uganda, Senegal, Malta, Myanmar, Ukraine, Georgia.

The first World Telemedicine Symposium for developing countries was held in Portugal from 30 June to 4 July 1997. The Symposium was an ITU initiative, hosted by the Portuguese Telecommunications Administration through the Instituto das Comunicacoes de Portugal (ICP). It was attended by more than 57 countries and for the first time it was many cases when telecommunication specialists were sitting together with doctors from the same country. It was a great success.

Let us take another example. Ethiopia is one of the least developing countries in Africa. The health care system is underdeveloped and able to provide health services to only about half of the population. There is a lack of doctors and health care infrastructure. Few medical specialists working in the country are concentrated in the big cities, in particular in the capital, Addis Ababa. Much of the rural population has no access to any type of health care. Within the limited financial resources it was recommended in Ethiopia to start the introduction of eHealth services with dermatology due to the shortage of specialists in this medical discipline and also because skin diseases are very common in the country.

Twelve hospitals were selected to be connected together via the Internet into eHealth information network. After teledermatology it could be also possible to add other eHealth services such as teleradiology, telecardiology, telepathology, etc. Of course, eHealth solution can not increase the number of doctors in the country but it helps to use available resources more efficiently.

IV. Needs for Cooperation

Introduction of eHealth services requires multidisciplinary collaboration with active participation of telecommunication operators and health care professionals. Therefore it is recommended according to the Resolution 41 of the WTDC-02 that the Member States of the ITU to consider the establishment of a national committee/task force comprising representatives from telecommunication and health sectors. This committee/task force has to be open to other interested parties to join it in order to coordinate all eHealth/telemedicine activities at a national level by concentrating the available resources and assuring the interoperability of different telemedicine systems.

The creation of national committees, associations, task forces and the like, with a multidisciplinary composition, is necessary to bring together telecommunication and health professionals, lawyers, industry and others to assist the preparation of the National eHealth Master Plan.

The National eHealth Master Plan has to be developed and it should be based on the modest step by step approach allowing the introduction of eHealth services together with training of doctors and nurses on how to use them. It is very important to make the right selection of a first pilot eHealth project which is playing dual role as a new tool for the delivery of health care and also as a component of promotion campaign to raise the awareness of decision - makers, health professionals, beneficiaries and other key players about the benefits of ICT for health care sector.

In developing countries, even hospitals located in the capital are not equally staffed with medical specialists and they have to cooperate with each other. This is an ideal case to offer these hospitals eHealth connection and allow them to make exchange of information about their patients electronically. The doctors or users will see the benefit immediately because eHealth/telemedicine connection is saving their time and improving the treatment of their patients. This situation is allowing the smooth integration of eHealth services into routine medical practice what is important at this early stage.

The Hospital Information System (HIS) is becoming the important and useful component of a modern hospital everywhere. This is a platform for eHealth services today and in the future. Not many developing countries can afford HIS in every hospital but the process of hospitals's "informatization" has already started everywhere and moving ahead. The limited information on uniform, international, multipurpose standards for the structure, content, and transmission of medical data seriously impairs the introduction of eHealth services in developing countries where interoperability is one of the most important requirements.

V. Role of Telecommunication

The role of telecommunication facilities can not be overestimated. It is a platform for any kind of eHealth services. Most of the communication and information technologies that can be applied to the health sector are common across other sectors or share common elements and solutions developed in sectors other than health could be adopted to solve problems in the health sector.

The beauty of some eHealth services is that even simple telecommunication facilities can be used for introduction of them. For example, the ordinary telephone line can be used for successful transmission of ECG and this information is playing important role in cardiology. Nevertheless, analog modem technology is gradually being phased out in favor of

digital transmission technologies with higher speed or bandwidth.

All available transmission telecommunication technologies can be used for the delivery of medical information if the transmission speed/bandwidth is enough for required quality. In practice of eHealth, data maybe transferred in different forms, ranging from high-quality, two-way, full-motion video to sound and still images. The optical fiber links are an ideal media for high speed/broadband communications. But the satellite technology is useful to reach remote locations and rural areas. Today with the widespread of mobile communication, this technology will be used in eHealth as well.

The Internet is becoming a popular tool for doctors to read clinical journals and communicate with other doctors, though doctor-patient e-mail is not catching on as rapidly even in developed countries where the density of computers is much higher compare with developing countries.

With the general trend for next generation of telecommunication networks to move from circuit-switched technology to packet-switched technology, eHealth networks will be used modern data communication networks.

The role of telecommunication operators in the introduction of e-health services is much more important in developing countries than in developed ones. The main interest of telecommunication operators is not to provide an additional new telecommunication service for the Ministry of Health and to get a new revenue stream. It is more important the contribution of the telecommunication companies to the well being of the citizens of their countries by helping to improve and extend the access to medical services. Therefore telecommunication operators in developing countries are partners together with doctors in the introduction of eHealth services.

There is a need to bridge the gap between the telecommunication and health care communities at all levels. National Ministries of Health and Telecommunications also need to work together towards introduction of a eHealth/telemedicine policy and achievement of universal service where emergency services, health and social information systems are concerned.

The medical doctors should take the lead in determining their needs and how eHealth might help. Of course, the implementation of such ambitious program would be done in several stages according to available resources but the vision and understanding of the problem for the whole country will give the chance to concentrate resources and avoid unnecessary duplication.

It is clear that the introduction of eHealth services has to be based on existed telecommunication infrastructure. Nevertheless many hospitals in developing countries have poor connections to the nearby telephone exchange and they often need assistance from local telecommunication operators on how this connection could be improved for high speed communication.

In order to allow a wide deployment of eHealth services and applications for the benefits of all, and in particular in developing countries, it is important to achieve interoperability among systems and to reduce the cost of devices through economy of scale. Consequently, the development of global international standards with the involvement of major players (governments, inter-governmental Organizations, non-governmental Organizations, medical institutions, doctors, etc.) is a key factor to achieve these objectives.

VI. Conclusion

There are already several successfully implemented eHealth projects in developing countries. Now it is a time for cooperation among developing countries in the introduction of eHealth services. For example, eHealth experts from India agreed to assist Nepal. There is a lot of eHealth experience accumulated in China, for example in medical distance training. There are excellent ideas with regard to home care, even traditional Chinese medical treatment can use telemedicine link for distance consultation. This knowledge is important for other countries. China could be one of the leader in development and introduction eHealth solutions and services.

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The Background on the Mobile Telemedicine Units Application in Telemedicine Services and Networks within the Outlying Regions

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Many situations arise where a basic medical examination of a subject is desired, but where medical personnel are not always available. Some examples are the following:

- Medically Under-served Areas. The number of fully staffed and equipped medical clinics in the world is relatively small, compared to the population and geographic area to be served. Frequently, a medical examination of a distant patient is desirable.
- Emergency and Occupational Medicine. Industrial mishaps and natural disasters sometimes occur at locations where medical facilities are not available. Further, even if such a facility is nearby, the extent of damage can over-tax this facility and require assistance of a more remote facility.

The most important conditions which should be considered when we introduce telemedicine to the outlying regions are: low population density; extensive transport communications (sea, river, air, motor car); insufficient infrastructure of land communication channels; a high probability of extreme situations and labour injuries; sometimes - heavy climate and weather conditions. Considering the above mentioned peculiarities, we may suggest the following patterns of telemedicine projects for the outlying regions: telemedicine in cities, telemedicine in small and temporary settlements, telemedicine in local regions-enclaves, telemedicine in mobile groups, telemedicine for navigation and off-shore platforms, telemedicine for native population, telemedicine for emergency and disaster relief. These projects don't exhaust all possible approaches to this problem. However, the fact is that the application of stationary telemedicine systems gets impossible or economically unjustified as we move to the outlying places.

The wide Mobile Telemedicine Units (MTU) application is to become one of the specific components of the Russian telemedicine system. The range of MTU markets is determined additionally by expeditionary, long shift work and other activities in the North, for instance. Here should be considered crews of sea-crafts (transport, icebreaking, survey vessels, geological), oil and gas drilling sea platforms. MTU can be used in aerial ambulances and other mobile medical services, by rescuers and forces eliminating consequences of man-caused (including ecological) and natural disasters.

Out task is to develop medical diagnostic unit which contains instruments by which a technician can perform a physical examination of a subject, and the apparatus contains a communication system that transmits results of the examination to a remote location for analysis by medical personnel.

In Russia we have an experience of working with some mobile units and its prototypes. MTU will allow communication and data transmission systems to maintain users' access to consultative telemedicine centers resources and other services of telemedicine systems and networks.

Keywords: telemedicine, mobile, space

Design of Low Cost Bluetooth Based Cardiac Telemonitoring

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This paper focuses in describing the design of low cost continuous cardiac telemonitoring system using Bluetooth. The system is capable of acquiring and storing of patients ECG data and transfers it in real time to remote locations. The system consists of biomedical signal acquisition and conditioning circuits, A/D converter and digital processing and wireless communication subsystem. The acquisition part acquires an ECG signal through electrodes and then amplifies the weak signal by an amplifier and filter out the same signal. The ADC module circuit performs A/D conversion of an ECG signal and digital output is sent to patients local PC through the wireless Bluetooth interface, which enables patient's data to be stored into a patient's local networked PC. The networking system establishes TCP/IP links across wide area communication to the physicians, located at central hospital for monitoring, diagnosis and create patient medical record at a significantly low cost.

Keywords: Telemedicine, telecare, cardiac telemonitoring, and bluetooth technology

I. INTRODUCTION

The use of electronic and communications technology to transfer medical information from one location to another, for diagnosis, therapy and education purposes, when distance separates the participants are called Telemedicine [1] [2]. The research in different areas of telemedicine has resulted in successful programs performing real time consultations [3]. Telemedicine reduce costs by enabling in continuous monitoring of patients, eliminating the need for utilization of expensive facilities and reducing the need for transportation of patients to physicians and medical centers [4].

There are various applications of telemedicine, but telecardilology is one of the most important ones for rapid transmission of electrocardiogram (ECG) data to physicians in order to enhance patient care and conserve healthcare resources in a managed care environment. ECG transmission for emergency settings has been particularly useful for reduce response time in control of sudden cardiac death victims [5] [6].

The low power, wireless based Bluetooth technology which allows the electrocardiograph to communicate with GPRS or UMTS mobile devices [7].

The continuous cardiac telemonitoring system provides direct access for high patient throughput areas, including emergency hospitals, critical care units and care at residential homes. The paper describes the bluetooth based low cost continuous cardiac telemonitoring system, comprises of signal acquisition and conditioning circuits, digital signal processing and wireless communication subsystem. The proposed design system would able to measure, collect, analyzes and records health care data at home-hospitalization and then subsequently sends these data to the central hospital via bluetooth interface over wide area links such as GSM, GPRS or UMTS or PSTN lines.

II. DESIGN SETUP FOR TELE-CARDIOLOGY

The typical Diagram illustrating the working principle of telecardiology based telemedicine application between a remote location and a big city is shown in figure. Those patients's which are at-risk, their signals which must be monitored continuously including, blood pressure, Oxygen saturation level (SpO2), body temperature, heart rate and electrocardiography (ECG) etc. The Electrocardiogram is the record of biopotentials measured on the body surface due to its electrical activity of the heart.

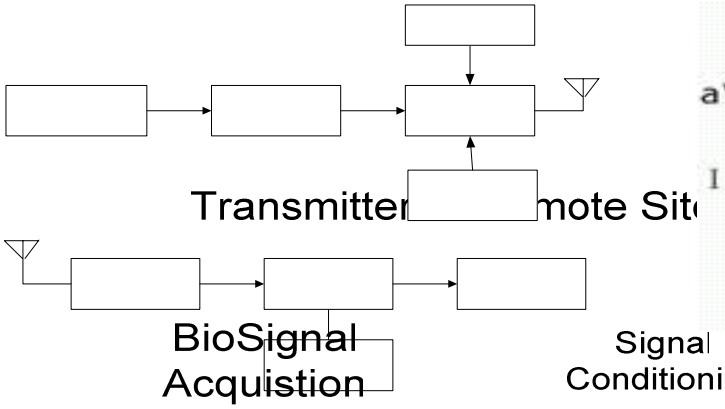

Figure 1: Typical tele-cardiology setup

III. WIRELESS CARDIAC SYSTEM DESIGN AND METHODS

We expect to have three design phases of different subsystems of the cardiac telemonitoring system consisting of biomedical signal data acquisition and conditioning, Analog to Digital conversions and digital processing and Bluetooth based RF wireless transmitter as shown in figure 3.

1-Biomedical Signal acquisition & conditioning

The bio-potentials generated by the muscles activity of the human heart result in the electrocardiogram [8]. Here we have considered the block diagram, which describes continuous monitoring patient's cardiac signal using biosensors, which have capability to measure the bio-potential from surface of the body. The measured signal is called the electrocardiogram (ECG). These signals to be recognizable by the microcontroller and therefore next are then passed through analog to digital converter to convert it into digitized signal.

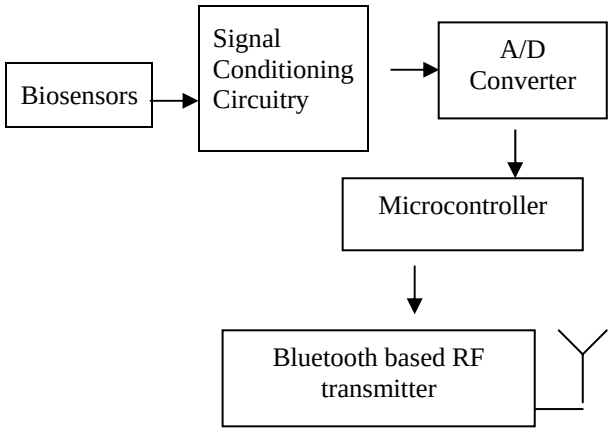

Figure 3: Block diagram of the Cardiac signal monitoring

Based on the cardiac potential different waveforms and amplitudes have been recorded using electrodes. The considered electrical axis of the heart that is examined by six of the standard leads: I, II, aVC, aVF and aVL as shown in figure 2.

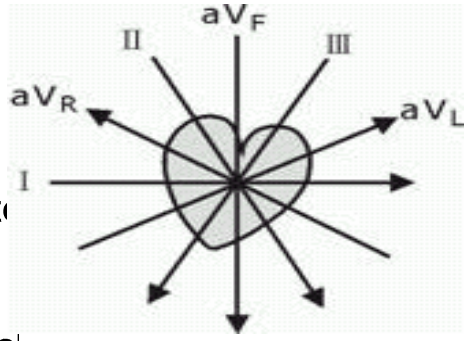

Figure 2: Block diagram of the Cardiac signal

These low level amplitudes of the bio-potentials, range from 1 to 5 mili -volts with its frequency range is from 0.1 to 100 Hertz, force to conditioning the signal for latter stages of the system. In order to overcome this problem, analogue circuitry with a precision instrumentation amplifier, with a gain around 1000 has been utilized.

2- A/D conversion and digital processing

In the next stage of the cardiac monitoring system, the analog output is converted to digital using A/D converter. In this context, our design uses a low cost 8-bit microcontroller, which sends the data via bluetooth based RF transmitter device.

3- Wireless transmitter

In this stage of the system, the wireless communication transmitter having Bluetooth standard has been designed, which allows the cardiac signal to be capture and stored in patient's personal networked PC without his/her mobility. The networking PC then establish a TCP/IP link with wide area communication standards such as GPRS or UMTS based mobile devices. However in the wireless Cardiac signal monitoring the need is for a short range and low power Bluetooth based wireless communication radio links that supports the frequency band of 2.4 GHz band with data transfer rate of 732 Mbits/sec and communicates with mobile devices within a range of 10 to 100 meters.

IV. RESULTS

Figure 4 shows the observation of the real time obtained cardiac signals, which has been displayed using Lab view software in order to confirm the quality of the acquired signal and analyze the performance of normal ECG signal that consists of a P wave, QRS wave and T wave occurs due to current generated by the depolarization of the arterial and ventricular contraction.

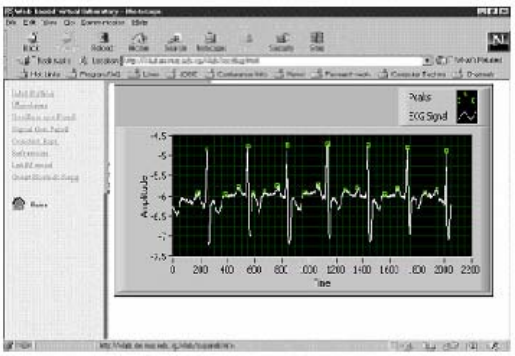

Figure 4 Displayed Cardiac signals using Lab view software

V. DISCUSSION

The overall objective of this paper is to design a low cost Bluetooth based real time Cardiac telemonitoring system, which replaces wired connections between home-hospitalization to the central monitoring hospital with wireless links. The Successful implementation of the final system would be of benefit to all involved in the use of electrocardiography as access to, and mobility of the patient would not be impeded by the physical constraints imposed by the cables. The proposed design utilizes wireless link to produce an ECG signal form the biosensors. Analog circuitry are used to obtain the signal and to filter noise, while
PC based lab view software is used to display the results.

VI. CONCLUSIONS

The focus of this paper has been to discuss comfortable wireless based bluetooth cardiac telemonitoring system, specialized to the needs of at-home hospitalization risk patient's. The system which would increase their wellbeing and the functionalities offer to physicians, has been designed implemented and tested. The principle goal were to achieve the size as reduced as possible and high quality of the signal.

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Exploring Natural Progression of Health-Related Uses of Mobile Phones: An Egyptian Case Study

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Abstract- The expansion of mobile phone networks and services to developing countries presents a strategic opportunity for the health sector to maximize the contribution of the technology to meeting health objectives. Mobile phones were first introduced to Egypt in 1997, in the past few years the number of subscribers has climbed to 14 million, representing 20 percent of the country's population. Along with increased access to fixed-line telephone services and emergency wireless systems, mobile phones are changing how health services are accessed by Egyptians as well as how they are coordinated. This paper explores the natural progression of mobile phone use for health in rural and urban communities in Minia Governorate, Egypt with the objective of informing projects and policies aimed at the formal integration within the health sector.

I. INTRODUCTION

As of September 2004, there were 1.52 billion mobile phone users reported in the world [18]. The technological advances of the twentieth century are increasingly becoming a part of the everyday experience of individuals throughout the world. Information dissemination, communication patterns, business practices, economic development and public health are changing as a result of improved access to mobile phones and other information and communications technology (ICT). The "Digital Divide" has become a mainstay of the dialogue on the differential access between rich and poor countries. It is defined by the United Nations Development Program (UNDP) as, "the gap between those who have access to, and can effectively use, new information and communication tools and those who cannot"

By 2003, mobile phone systems had become available in over 90 percent of all countries, an improvement from 30 percent ten years prior [12]. This spread has also enabled the increased use of the Internet through wireless connections. Mobile phone towers have become cheaper, easier, and faster to install than lying fixed-line copper wiring. Some countries have embraced mobile phones more than others, depending in part on prior access to fixed-line telephone services, telecommunications regulation policies, direct foreign investment in mobile phone services, and cost-benefit to potential individual and corporate subscribers.

In Egypt, competition from mobile phone companies has also influenced increases in fixed-line telephone services due to the fear of lost revenues for government provided telecommunication services. The result is a general improvement in telecommunication irrespective of modality. The Millennium ICT goals for 2006 are that lower-middle and low income economies have greater than 90 percent mobile population coverage. This includes both fixed-line telephones and the ability within a geographic area to receive mobile cellular signals [9].

With such growth in access to telecommunications, it is incumbent upon both the development and public health communities to become more strategic and proactive in terms of how they integrate and use the technology to promote improved livelihoods and health outcomes. So far, the major social impact of mobile phones of interest for poor countries has been economic development through the enhancement of small businesses and micro-credit and enterprise schemes. Throughout the world, poor countries, where there were no previously available fixed-line telephone systems (Rwanda, Uganda, etc.) are replicating what has been deemed a success in Bangladesh, The Grameen Bank's Village Phone Program, to increase household income through micro-enterprise ventures for women by enabling them to sell mobile phone air time [1].

Mobile phones can be found in almost any village, and have significant implications particularly for areas which still do not have access to fixed-line telephones. Mobile phone service is provided through a network structure that enables access in places where most other technologies are not available. Until recently, there was very little research done and nearly no documentation of the potential impact that improved telecommunications or more specifically that mobile phones might have on development or health. In the quote below, Anthony Townsend attributes this to a general preference for the study of the Internet.

> [Unfortunately] the advent of inexpensive mass-produced mobile communications in particular, has avoided scholarly attention, perhaps because it seems pedestrian compared to the nebulous depths of cyberspace. Yet the cellular telephone, merely the first wave of an imminent invasion of portable digital communications

> tools to come, will undoubtedly lead to fundamental transformations in individuals' perceptions of self and the world, and consequently the way they collectively construct that world. [14]

Mobile phones are more accessible to individuals than the Internet and their merging with computer technology is altering how societies approach health care in unprecedented ways. For example, there is a mobile phone, digital camera, and handheld computer hybrid that enables data and image collection and transmission with the potential to promote decentralized telemedicine and disease surveillance capabilities. More recent studies are indicating, however, that technology developers have grown interested in how their technologies might be modified to reach out to non-user groups in an effort to expand their markets. Such advancements could also contribute to minimizing the digital divide through increased access and uptake of mobile phones [7].

As a result of the increasing numbers of subscribers in developing countries, there is a critical need for academic research on the health benefits of mobile phones. Much of the research that has been done is based in developed countries and primarily focuses on the domestication of mobile phones for social purposes and potential health risks. There are only a limited number of case studies on the use of mobile phones for health in developing countries where the main focus has been on the use of text messaging for drug compliance, particularly for the treatment of tuberculosis and now for HIV/AIDS in South Africa and other Sub-Saharan African countries [13]. Parallels have been drawn to other technologies, including two-way radios, however, these devices remain under control of a few individuals and are predominantly stationary [6].

By mapping the relationships between mobile phones, society, and health services, the public health community will have a better understanding of the issues involved in measuring the health impact of the technology with their growing use in developing countries. This research increases the collective knowledge of the mechanisms by which mobile phones support the achievement of health objectives, including improving access to and utilization of quality emergency and primary health care services.

Study Background

This study has primarily been situated and informed by case studies in ICT for Health and Development, mobile phone trends in society, and theoretical frameworks in the field of Science and Technology Studies (STS). These resources provide a rich multidisciplinary lens for looking at the complex relationships between individuals and objects through the exploration of context, history, culture, gender, ethnicity, geography, as well as socio-economic factors. Three key sub-theoretical frames within the broader study of STS which I consulted in relation to the question of mobile phone use for health were Actor-Network Theory (ANT), Domestication of technology, and Public Understanding of Science (PUS).

The primary aim of my study is to identify the direct and indirect health benefits of mobile phones in Egypt. This is not a subject with any pre-existing empirical data, nor are there any known studies that have been done on the use of mobile phones for health promotion in any context. In Egypt, as in other countries, mobile phones produce both direct and indirect health benefits, especially when it is acknowledged that health encompasses medical interactions and general well-being. Among health professionals work-related uses generate direct health benefits and social uses contribute to well-being. Among lay users the effect is the opposite, work-related uses contribute to social well-being, and a by-product of possessing the technology is the increased capacity to mobilise support for emergencies and routine health care. Throughout my research and more explicitly during data analysis, the main focus has been to understand the domestication of mobile phones for health coupled with the notion that based on the data generated recommendations for more formalized health interventions could be made and tested.

Health and Mobile phones in Egypt

Egypt was selected as the study country because the rural and urban mobile phone networks are highly developed. There was a critical mass of individual users that had acquired the phones for personal and business purposes. A new Ministry of Telecommunications and Information Technology (MCIT) had been established in Egypt and has been actively engaged in exploring the potential social impact of ICT on Egyptian society. In September 2002, I returned to Egypt to collect data, which I was able to complete in early 2003. The data presented in this thesis provide information from within the health sector as well as domestic settings for the application of mobile phones for health as well as potential applications to other sectors.

With the appropriate permissions obtained from the Ministry of Health, I conducted the study in the governorate of Minia. Minia Governorate is located in Upper Egypt (southern part of the country) and contains Minia town and 57 villages. In 1995, it had an estimated population of over 3.3 million [3], and was chosen because it is an area that would benefit from leveraging improved access to telecommunications infrastructure for health promotion. It also provided an interesting cross section of people of varying socioeconomic status as well as remoteness to health facilities, where members of particular communities have to travel for four to five hours to reach a health facility on boat, foot, and donkey. Minia maintains a combination of attitudes and behaviours that reflect those of the Northern part of Egypt (Lower Egypt) and the aspects of the Southern part (Upper Egypt), making it an ideal setting for conducting research that would potentially be reflective of the country at large.

Recent movements within Egypt to harness the potential of information and communication technology have resulted in strategic developments for the integration of technology in both the education and health sectors [4]. Egypt has the health infrastructure to integrate technology to better respond to the health needs of the people. However, the system requires significant changes to make this possible. In this section, I explore the historical and present day context into which mobile phones have been integrated into Egyptian society as well as initial perceptions surrounding mobile phones as represented in the media as well as by respondents.

Egypt has been categorized as a *lower middle income* country by the World Bank along with countries such as Colombia, Dominican Republic, Jordan, and Thailand. The Gross National Income (GNI) per capita was $1,490 USD and the Gross Domestic Product was $98.7 billion USD in 2000 with an annual growth rate 5.1 percent [17]. Egypt's health expenditures as a percent of GDP were 4.6 in 1998 with public sector health expenditure as 30.8 percent of that [11]. One of the major problems in Egypt as in many countries is an uneven distribution of wealth. Twenty-two point nine percent (22.9%) of Egyptians lived below the poverty line in 1995-96 and 52.7 percent earn less than $2 USD per day [17].

Life expectancy has risen significantly over the past sixty years. In 1940 it was thirty-one years for males and thirty-six years for females [5]. In 2000 it was 65.4 for males and 69.1 for females [11]. These figures are slightly lower than other *low middle income* countries [17]. Mortality of children under five years declined to 52.2 per 1000 in 2000, but remains higher than other low middle income countries [17]. In 1999 the infant mortality rate was 41.8 per 1000 [17] and the maternal mortality ratio (MMR) was 170 per 100,000 live births [11]. The maternal mortality ratio in Egypt is significantly higher than other *low middle income* countries. For example, Jordan and Thailand had MMRs that were 41 and 44 per 100,000 live births respectively in 1995 [16]. One area that public health professionals have recommended that mobile phones be integrated into health systems is to address obstetric emergencies. Mortality and morbidity statistics remain particularly high in rural areas in Upper Egypt including Minia where education and access to medical care are lower than the rest of the country [4].

At the time of my data collection, a recent study of fixed-line telephones in Egypt looking at teledensity (number of working telephone lines per 100 inhabitants) and teleaccessability (number of home lines per 100 households) had been conducted in Egypt to determine the telecommunications infrastructure needs of the country. The study determined that the overall teledensity of Egypt is 9.82 with teleaccessibility at 40.37 [8]. These statistics vary significantly from urban areas to rural. For example, the governorate of Cairo's teledensity and teleaccessibility were 24.38 and 84.15 respectively, while Minia, a predominantly rural governorate, had a teledensity and teleaccessibility of 3.21 and 14.41 respectively in 2001 [8]. Poorer, more rural regions have much lower access to working fixed-line telephones [8].

The figures for Egypt have since continued to increase to 10.4 million fixed-line telephone and 14 million mobile phone subscribers reported at the end of 2005 [10]. Although they have more than tripled since data for this study were collected, the health benefits derived from improved telecommunications would theoretically remain similar or increase as well. The profile of the mobile phone user is quite diverse. In my study sample, there were a range of professionals who felt that the mobile phone would facilitate their work. The major groupings included medical professionals, mostly health administrators, physicians and pharmacists; businesspeople- especially engaged in the buying and selling of goods; truck and automobile drivers; and students. People who travel for work and study are also more likely to invest in buying a mobile phone.

Before mobile phones, most Egyptians outside of the major cities had to go outside of the home to make phone calls. Their options included not making phone calls (and '*leaving things to God'*), telegrams, local telephone stations known as *centrales* mostly located in urban and peri-urban communities, pay phone booths, and private land-lines owned by wealthier neighbours willing to share their fixed-line in emergency situations. Although mobile phones are accessible and utilized, it is worth noting that respondents expressed a general preference for fixed-line telephone services. It is significantly cheaper, and when they were available respondents chose the fixed-line telephones over mobile phones.

II. Methodology

There is limited knowledge of the health-related uses of mobile phones in Egypt (and indeed elsewhere), and so I primarily relied on ethnography to explore the intersection between key social constructs associated with mobile phones and health. This was supported by the use of qualitative research methods to provide descriptive explanations for how the introduction of mobile phones affects segments of society in a particular context, namely health professionals and those who access health services through the use of mobile phones in Minia Governorate.

Using an Ethnographic Field Guide as a starting point, I developed a series of open-ended questions used in a variety of configurations depending on the type and nature of respondents, health professional or otherwise as well as non- and former users. The questions focused on their general and specific thoughts on health when and since mobile phones first became available in Egypt. Additional questions regarding professional applications of mobile phones and changes in health service provision were included for health professionals.

During four months in Egypt, 66 in-depth interviews were conducted with a variety of key stakeholders both within the health sector as well as in the local population at large in the governorate of Minia. The following is a summary of the types of respondents that I interviewed. Of the 66 individuals interviewed, 53 were current mobile phone users, ten were non-users, three were former users; 44 were men and 22 were women; and 24 were health professionals and 42 were lay persons. Respondent ages ranged from 19-51 years.

III. Results

This study contributes first and foremost to the practice of public health in developed and developing countries with a specific focus on settings which did not have functional telecommunications infrastructures prior to the introduction of mobile phones. Through the analysis of empirical data, the following four findings were identified and provide major contributions to ongoing learning about the potential of mobile phones to support health objectives.

1. Mobile phones enable access to and coordination of a broad range of emergency health services.

2. Mobile phones improve access to and coordination of routine health service delivery and specialized information.
3. Mobile phones indirectly support health through improved well-being from enhanced family communication.
4. Limitations to mobile phone use for health should be addressed within any program or sector-wide intervention aiming to formally integrate the technology.

Health benefits

Each of these findings contributes to the greater understanding of the direct and indirect health benefits of mobile phones as well as the four study objectives established to provide structure to achieving this broader aim. Changes within health services were clearly observed particularly through the domestication of mobile phones by health professionals as well as lay users accessing health services. The domestication of mobile phones for health professionals include enhanced health service administration, increased remote patient monitoring, and disease surveillance and prevention. The benefits expressed were an increase in work efficiency and mobility. For lay users improved access to transport and health services (emergency and otherwise) were the primary benefits. Improved access to health information transcended lay users to all users, including telemedicine, health care provider- patient exchanges, and referral systems.

Additional perceived positive changes include: decreased emergency response time, increased remote interactions with patients and other physicians enabling a physician to maintain multiple professional roles simultaneously, easier access to health professionals enabling patients to assert more control over their interactions with physicians and treatment regimens, and improved facilitation of disease surveillance, prevention, and control. Maternal and child health (MCH) was the primary intervention area highlighted by health professionals that would benefit the most from improved telecommunications and movements in this area are already taking place. However, there were very few real life examples that emerged among study participants. As a result, it is not possible to make specific recommendations in this area for formal integration based on the natural progression of health-related uses of mobile phones.

The family is the key unit of individual and collective action in Egypt. This was not purposefully sought within the study, but came out in people's descriptions of their mobile phone use particularly in terms of families as points of support coordination in emergencies, mothers as intermediaries, and family communication for promotion of well-being and security. Mobile phones have become available at a time of dynamic social change in Egypt that is characterized by increasing distances between members of immediate and extended families.

Limitations

It is important to note that the benefits of mobile phones for health can only be maximized if all of the elements in the network, including health facilities and existing fixed-line telephones are perceived to be "accessible." Within the empirical data the key findings with respect to limitations to maximized use of mobile phones for health in Minia Governorate were 1) cost, 2) risk perceptions, 3) reliability of telephone systems in health facilities, 4) safety, liability, and cost recovery for unknown contacts as well as information and services provided at a distance, 5) lack of understanding and use of range of functions available through mobile phones, and 6) poor quality of health services. It is also important to acknowledge the potential obstacles posed by differential access to mobile phones within the hierarchy of health professionals. Overcoming barriers is a strong feature within the literature on ICT for health and development in poor countries as the primary objective is to ensure effective use of the technology and positive outcomes. This aspect of technology study explores aspects of barriers such as literacy, hierarchical access to technology, appropriate infrastructure to support the use of technology, and cultural factors that inhibit the use of technology.

IV. DISCUSSION

In this discussion, I present three overarching discussion themes that emerged during the research process. The first theme is the contextualization of mobile phones within a broad network of technologies and people. The second theme is the movement towards a *telecommunications herd immunity*. Third is the creation of intermediaries.

Contextualizing mobile phones within broader network

It is critical to understand mobile phones in a broader context of use as well as health and development objectives. In Minia, there is a complex web of elements working simultaneously to advance and impede the use of mobile phones as a tool for health. Network elements and interactions provide a macroscopic foundation for understanding how mobile phones are being domesticated within the health sector and in domestic settings for health. This includes the importance of the combined usage of a range of information and communication technologies available to and being used by health professionals and lay users to access health services and coordinate service provision, including emergency wireless systems and fixed-line telephones in households and health facilities. Within routine service delivery there were fewer technologies under consideration, however, more service delivery outlets for consideration and sorts of health care providers that are involved in routine care than for emergencies, including pharmacists, rural health centres, and specialists. Again as with emergency care, lay health applications are mostly associated with mobilising transportation and phone consultations with health professionals and mothers as care providers.

The value of connecting to a network depends on the number of other people connected to it [7]. With each increase in the number of doctors and other health service providers as well as lay users that have mobile phones and/or fixed-line telephones, their utility improves. For health professionals and lay users that did not have mobile phones, they were able to reap the benefits as there were enough people with the technology to enable them to reach and be

reached by others as needed. In the public health lingua franca I liken this to a sort of ***telecommunications herd immunity*** for health professionals and the general public.

Telecommunications herd immunity

In vaccination programs, the notion of *herd immunity* states that if a specific critical mass of individuals within a population have been immunized against a disease that the entire population benefits and is protected from the disease. In my study in Egypt, the increase in the numbers of mobile as well as fixed-line telephones is benefiting many more than simply individual owners and subscribers. It is benefiting the general population as the overall teleaccessibility (number of lines per 100 households) increases. The way this manifested itself in the study was that a number of respondents shared their accounts of altruistic behaviours in which they either found themselves in an emergency situation where someone called for help on their behalf or vice versa. In the case of telemedicine and improving access to health services, the more health professionals have access to telecommunications the more accessible they become to each other as well as to their patients.

Intermediaries

Within the network, environmental factors are also influencing utilization patterns and the creation of "middlemen and women" to facilitate access to health services and information. Oftentimes technology advancements are thought to eliminate "middlemen" [2]. In the case of changes within health services in Minia, Egypt a new sort of "middleman and woman" has evolved, what I have called the *intermediary*. In the case of information transfer and communication, the family has become the new primary intermediary as a central point for communication to access emergency transportation, health services, and information. The use of intermediaries in Minia was largely due to the desire for individual mobile phones users to work around the cost structure of mobile phone companies and the delays and frustrations with receiving accurate guidance from emergency call centres.

focus on the role of family members as intermediaries in mobilising support in emergency health situations. In Egypt, the family is the focal point for decisions regarding mobile phone use as well as health. Addressing emergencies was presented as a key motivation for the purchase of mobile phones for use in domestic settings. Mobile phones are a part of the household strategy to preserve physical well-being and mitigate the impact of difficult situations particularly in relation to automobile and other travel related accidents. Indirect health-related benefits observed within family communication for well-being include potentials for increased household income through enhanced business opportunities for men and opportunities for more formal work outside of the home for women. They also include enhanced access to educational opportunities particularly for university-age girls, improved family communication (husband-wife and parent-child), enhanced youth relations and interactions, and increased self esteem for boys.

V. Conclusion

Egypt as a context for exploring the domestication of mobile phones for health can be used to inform public health efforts in both developed as well as developing countries. Its uses in mobilizing and coordinating emergency health care are universal. Establishing an advanced warning system for health facility staff of incoming cases for better preparedness and service delivery is one potential intervention for a more systematic application of mobile phones in emergency situations. Its potential uses with respect to general health services become more dependent on the cultural norms surrounding treatment seeking and provision.

A more strategic use of mobile phone functions such as text messaging to mobilize multiple practitioners is a cost-effective means to integrate the technology into health service delivery systems. There are already examples of applications of mobile phones to infectious disease prevention, surveillance, and control particularly with respect to Polio in Bangladesh and HIV/AIDS, and TB in South Africa and other parts of Africa. In Egypt, the extended application to food-borne epidemics also raises the potential for their use in addressing public health concerns such as Avian Flu. Where other technologies are available mobile phones ought to be used in combination with two-way radios, fixed-line telephones, and satellite phones to maximize benefits and minimize cost. Overcoming barriers to accessing health services including distance, cost, and poor service quality must be addressed in any formal integration program.

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A Comparative Overview of E-Health Development in Developing and Developed Countries

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The access to the Internet and modern telecommunication infrastructure is an important requirement for the development of economies in developing countries. The World Health Organization (WHO) has identified e-Health (Healthcare using Internet technologies) as of prime importance for the economic development of developing countries. Hence the deployability of e-Health is emerging as a major indicator to the progress of telecommunication development in developing countries. In this regard, the world has seen the evolution of a number of international initiatives led by U.N bodies, such as the International Telecommunication Union (ITU-D), World Health Organization (WHO), Tele-Medicine Alliance (TMA), IEEE and a number of organizations. This paper provides a comparative overview of the development of e-Health in developed and developing countries.

I. INTRODUCTION

"Tele-Health allows physicians and health care specialists to diagnose and treat patients over distances – whether that span is across a street, a city, a region or an ocean. Tele-Health can prevent uncomfortable delays, high travel expenses and family separation by bringing specialized medical care directly to the people who need it. It is being practiced in rural areas, school districts, home-health settings, nursing homes, cruise ships, and on NASA space mission...Recently, the term tele-Health has risen as a favourable expansion upon the word telemedicine; tele-Health includes non-clinical services such as medical education or research." [TELE05]. e-Health expands the envelope of tele-Health to include various aspects of healthcare (using the Internet technologies), such as Electronic Health Records (EHR), health insurance, pharmacy, health administration, public health and m-Health (using wireless mobile technologies).

There have been substantial developments on e-Health in the developed world to reach healthcare to remote communities, such as the outback in Australia and the Alaska region in North America. As discussed later in this paper, e-Health has the potential to alleviate, to some extent, the problems of healthcare due to the ageing population and increasing percentage of chronic patients that require close attention.

The motivation and commitment to telemedicine in developing countries (facing problems of infrastructure and growing population) is often backed by a willingness to pay for systems that are expected to improve health outcomes and lower medical costs in the long run. Telemedicine services may be perceived as more of a necessity in developing countries than they are in the developed countries, resulting in a greater willingness among the former to change established methods of doctor-patient interaction and health care administration. ITU-D Question 14 (telecommunication for healthcare) has been looking at this problem since 1995 and it has analyzed the introduction of e-Health services in many developing countries. The findings present some compelling case for the need for telecommunication for healthcare in view of the following as illustrated in this paper [AND05]:

- These countries suffer from a severe shortage of healthcare professionals
- The population living in rural areas suffers from the lack (or absence) of healthcare
- High maternal and prenatal mortality rate (as high as 30% in some cases)
- Very few doctors (in rural and remote areas) have access to medical journals
- Most hospitals and healthcare centers have a poor telecommunication infrastructure.

IEEE Communication Society sponsors an annual event called Healthcom to discuss these issues [KWAK05]. The success of Healthcom (nurtured since 1999 by the ComSoc Technical Committee on Enterprise Networking-EntNet) has led to the recent IEEE/ITU-D Mobile e-Health initiative for developing countries. This initiative currently involves twenty countries and efforts are underway to trial a range of mobile e-Health architectures for addressing a range of e-Health

problems (e.g., disasters like Tsunami and pandemics like bird flu) in developing countries as discussed in this paper. This initiative is now growing with the support of World Health Organisation (WHO) that has given a high priority to e-Health in its efforts to reach healthcare to citizens located in remote communities. The local chapters of IEEE Communication Society in India and Asia-Pacific are helping promote this initiative by hosting Healthcom and this paper summarizes some of the deliberations in recent Healthcom events involving IT and healthcare professionals in developed and developing countries.

In view of the paramount importance of multi-disciplinary, multi-organization, multinational collaboration on e-Health, this paper provides a comparative overview of e-Health in developed and developing countries based on the involvement of the authors in international initiatives. The paper starts with an overview of work done in ITU-D on telecommunication for healthcare. This is followed by the recent status of e-Health in developed and developing countries with respect to initiatives led by international organizations, such as ITU-D and WHO. The paper concludes with the 2005 WHO resolution on e-Health

II. BACKGROUND

ITU-D Focus Group 7 has spent a year around 2004 researching technological developments that have the potential to support telecommunication applications which are commercially viable, or sustainable through other transparent financing mechanisms, in rural and remote areas of developing countries that exhibit[ITUDF05].

_ scarcity or absence of reliable electricity supply, water, access roads and regular transport;

_ scarcity of technical personnel;

_ difficult topographical conditions, e.g. lakes, rivers, hills, mountains or deserts, which render the construction of wire telecommunication networks very costly;

_ severe climatic conditions that make critical demands on the equipment;

_ low level of economic activity mainly based on agriculture, fishing, handicrafts, etc.;

_ low per capita income;

_ underdeveloped social infrastructures (health, education, etc.);

_ low population density;

_ very high calling rates per telephone line, reflecting the scarcity of telephone service.

These characteristics make it difficult to provide public telecommunication services of acceptable quality by traditional means at affordable prices, while also achieving commercial viability for the service provider. Telemedicine and e-Health are perhaps the applications of highest impact for the development of society using telecommunications as discussed in this paper.

Telemedicine and tele-Health applications are not limited exclusively to expensive, high bandwidth services. As long as the local medical community remains motivated and committed to implementing telemedicine and tele-Health programmes, there are a wide range of health benefits that can be achieved through remote patient monitoring and diagnosis, multimedia communication links between urban and remote facilities, and broadcast of health information over radio and television [ITUDF05].

III. DEVELOPED COUNTRY PERSPECTIVE

Although developed countries have a mature telecommunication infrastructure, e-Health and tele-Health practices have not really proliferated to expected levels, except in remote regions, such as Alaska. Perhaps this is due to reasons other than the availability of adequate telecommunication infrastructure. However, the following examples illustrate the potential contributions of tele-Health and e-Health to the progress of the society.

In the Boston area, home health-care nurses use digital cameras to take photos of patients' skin wounds and surgery decisions. The nurses transmit these images miles away over phone lines to wound-care specialists who compare the lesions with images taken a few days earlier and, if necessary, recommend a change in care to prevent more serious conditions.

Across Pacific, dozens of asthmatic children use Web cams in their homes to send videos of themselves using their inhalers and airflow measurement devices. Case managers at tripler Army Medical Center at Hawaii watch each recording to evaluate patient conditions and electronically send back pointers on how the youngsters can more efficiently control their asthma and save scary trips to emergency trips rooms [McGE04].

3.1 Motivations

The following reasons justify a more serious approach to e-Health [SILB03]:

- E-Health is the single most important revolution in healthcare since the advent of modern medicine and hygiene
- There are numerous success stories all over the world, particularly in the developed world
- e-Health has the potential to extend healthcare efficiently to nearly 40% of the population of developing world, where healthcare is almost non-existent.

Some of the driving forces for the 2010 Telemedicine Vision of TMA (Alliance of WHO, ESA and TMA) are [TMA05]:

An aging population: Because of demographic trends towards older age, more citizens will have one or more life-restricting conditions or chronic illnesses for which this model is particularly adapted (homecare).

Quality-of-care and care delivery: Unnecessary repeated tests, too many fatal errors, limited possibilities of 'hospital-at-home' type care, are only a few of the driving forces for e-Health.

Cost: The rising cost of healthcare has become a critical problem throughout Europe. This situation begs for more efficient organization as well as the added capabilities offered by virtual access via Telemedicine technologies.

Mobility: There is increasing intra-European mobility of the population in tandem with the increasing

internationalization of companies and organizations and the disappearing borders between States.

Technology: Although the reasons for realizing e-Health are not, and should not be, technology-driven, the ubiquity of communications and information technology and the resulting expectations of the society lead to this direction.

Consumerism: As with most other services in today's society, healthcare cannot continue to escape the expectations of increasingly informed and demanding patients. New services and added values will be able to emerge for the advancement of knowledge and care, for education and prevention, and for social services and more efficient warning system.

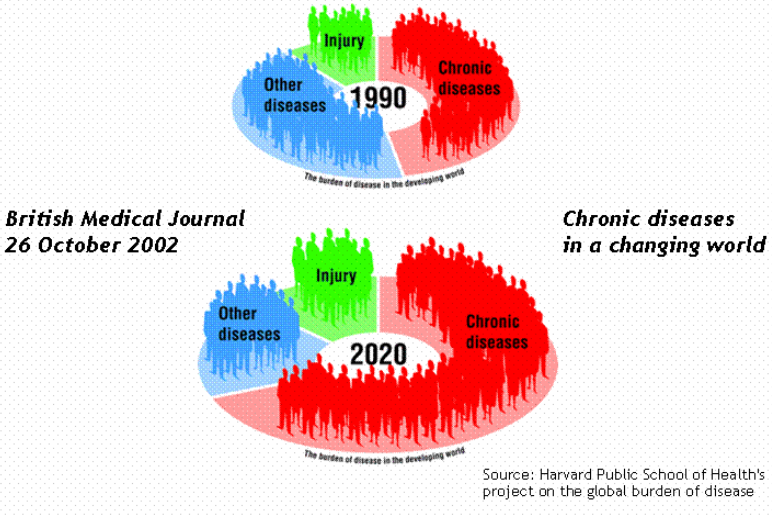
Figure 1 substantiates the scenario of problems caused by ageing population. One of the side effects of ageing population is the growing percentage of population with chronic illnesses that require continuous medical attention that will become more and more difficult at the hospital level by traditional methods of healthcare. Hence there are worldwide efforts to provide smart home-based remote care using intelligent e-Health mechanisms.

3.2 Many Faces of e-Health

Unlike many other e-business areas, healthcare offers some major challenges due to its high complexity involving the interplay of a number of sub-disciplines, such as nursing, radiology, pathology, cardiology etc. Hence there is a strong need to develop an integrated e-Health architecture that involves a multi-disciplinary approach comprising of:

- Clinical Data Management
- Decision Support Systems
- Technical, Hardware and Network Issues including telemedicine
- Database Structure and Constraints
- Autonomous Smart Devices
- Standards for Communication between Healthcare Providers
- Data Exchange Standards for Healthcare Devices
- Legal and Ethical Considerations
- Patient-Oriented Computing

Figure 1: Healthcare Problem in Developed Countries due to the Ageing Population



3.3 Recent Developments

e-Health is now making fast progress in the fast growing Asian region in countries, such as Korea, Taiwan and Japan thanks to their already established broadband communication infrastructure that covers nearly 75% of the population. Hence these countries are now pioneering the paradigm of Ubiquitous Healthcare (u-Health) that makes healthcare facilities available to all in the country through broadband wired and wireless mobile communication infrastructure. Such a paradigm is very useful in disaster situations that require the quick establishment of healthcare services, in spite of the breakdown of the infrastructure at the site of disaster. Healthcom2007 (sponsored by IEEE ComSoc) will showcase these technologies in Taipei in June 2007.

That brings up the connection between security and e-Health for countries. The Asia Pacific Economic Cooperation (APEC) e-Health Initiative aims to promote dialog and knowledge sharing amongst developed and developing countries in this region for basic requirements (standardization, law and policy making, human resource development, R&D), key barriers, strategies and imperatives for "The World agenda for Prevention and Treatment for Global Diseases (SARS, bird fu etc.) through e-Health, "Global Risk Management through e-Health", and "e-Health for under-privileged without access to medical services" [KeHA05].

The next section presents the perspective of developing countries that face problems with the telecommunication infrastructure that call for innovative solutions for e-Health.

IV. DEVELOPING COUNTRY PERSPECTIVE

e-Health is becoming a major agenda in the goals of international development with a view to bridge the gap between developed and developing countries. Until recently, approx 40% of the population in developing countries did not have basic healthcare, and the computer communication technologies could play a major role in this development, as per the recent e-Health communiqué from the World Health Organization (WHO) [WHO05]:

- Today, e-Health – understood in this context to mean use of information and communication technologies locally and at a distance – presents a unique opportunity for the development of public health. The strengthening of health systems through e-Health may contribute to the enjoyment of fundamental human rights by improving equity, solidarity, quality of life and quality of care.
- Member States and groups of Members States are drafting their own strategies for e-Health, and other organizations of the United Nations system have drawn up strategies for information and communication technologies in their domains.

4.1 Potential Impact on Health

e-Health may be expressed in terms of digitalized products, systems, and services for health. These technologies hold great promise for both low- and high-income countries, and some are already realizing the benefits. These benefits apply not only to health-care delivery, but also to public health governance, finance, education, research, and other economic activities.

e-Health should have an impact on health systems by making health services more efficient and improving access to care, especially in remote areas, for people with disabilities and for the elderly. It should benefit health-care providers, professionals, and final users through higher quality of care and health promotion. It should also affect the cost of care by reducing redundancy and duplication of examinations and making possible economies of scale.

4.2 Global and National Challenges

There are many partners involved in health who are not only the beneficiaries of, but also a driving force for, use of e-Health in different countries. For example, many developing countries rely on the recommendations of ITU-D for the development of telecommunications (handled by the ministry of communications in each country). On the other hand, these countries are heavily dependent on the WHO for healthcare policies and processes (handled by the ministry of health in the country).

Flow of health data no longer has any barriers. It is essential to evaluate and share experience in order to develop individualized cost-effective models and, in particular, to understand the determinants involved in the adoption and sustainability of e-Health.Although this situation needs regulating, it is also an opportunity for faster and more comprehensive epidemiological surveillance. A global approach to handling data flows will help to promote standardization and low-cost services as evidenced with the establishment of a number of specialized international healthcare networks for the control of healthcare problems, such as HIV-AIDS and pandemics.

Technological excellence is growing in low-income countries, which are developing their own expertise. However, for many the benefits expected of e-Health have not yet materialized, and it is difficult to predict the rate and extent to which information and communication technologies will affect diverse health systems. Prerequisites for the successful integration of e-Health into health-care systems include long-term government commitment, based on a strategic plan, national awareness of the benefits of e-Health, and availability of skilled human resources.

In order to demonstrate the benefit of e-Health solutions and services, the Telecommunication Development Bureau of the International Telecommunication Union has implemented several pilot projects in different developing countries as summarized below [AND05]:

While healthcare organizations need guidelines for e-Health deployment, telecom operators view e-Health just as another source of revenue stream. Hence there is a strong need to develop and disseminate global guidelines for e-Health, and the WHO has now embarked on a major initiative involving many developing countries to systematically collect evidences of e-Health benefits and uses with a view to develop a set of e-Health implementation guidelines.

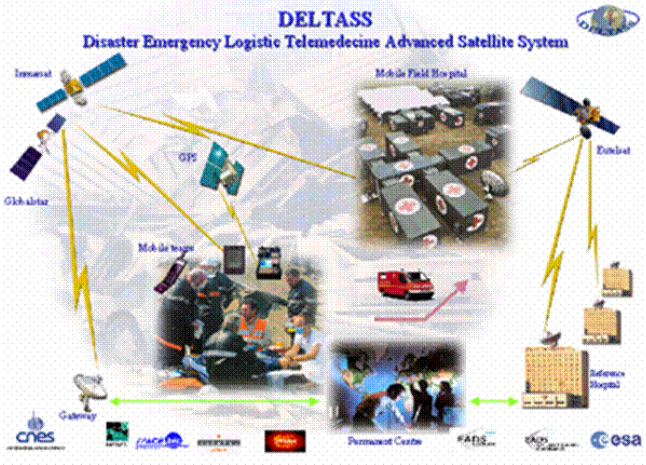
Country	Year	Subject
Ukraine	1998	Mobile handy-phone system in hospital
Mozambique	1998	Teleradiology
Malta	1998	Telemedicine link between two islands
Myanmar	1998	Teleradiology
Georgia	1999	Transtelephonic ECG monitoring
Uganda	2000	Teleconsultation
Senegal	2001	Teleradiology, Teleconsultation
Ethiopia	2004	Teledermatology

4.3 The Technological Viewpoint

It seems the developing countries face a number of problems including the lack of telecommunication infrastructure. Hence satellite communication has a strong role to play in enabling e-Health in developing countries. Figure 2 shows the role of satellite communication after the destruction of communication infrastructure in disaster situation.

Most developing countries use satellite technology for international rather than for domestic communication. In the future, there should be substantially increased domestic and regional use of satellite technology. The potential exists in this application for enormous increases in traffic, and the impact on developing countries' economies will be the greatest [CHAS95]. Figure 2 shows the European Space

Figure 2: Satellite-based Disaster Management



Source: http://telecom.esa.int

Agency (ESA) satellite-based communication framework for disaster management involving the cooperation of multiple organizations.

Many organizations are working on digital bridges projects, such as Volunteers in Technical Assistance, Canadian International Development Agency, Swiss Agency for Development and Cooperation, Global University System, World Bank's info Dev program, ITU, World Links for Development, International Food Policy Research Institute, various organizations based in Africa, and innumerable mailing lists. [AFEL03].

We now present a case study of e-Health development in the Tsunami-affected Aceh region in Indonesia using mobile wireless technologies.

4.4 M-Health Case Study

Wireless mobile information technologies are helping developing countries to quickly adopt e-enabled services for economic and social development. The International Telecommunication Union (ITU-D) has launched the e-health initiative (Question 14-1/2 of Study Group 2) for the development in the healthcare sector of the economy in developing countries. This document gives a summary of a new collaborative initiative between ITU-D and the IEEE Communication Society for the development of e-healthcare in developing countries using wireless mobile information technologies.

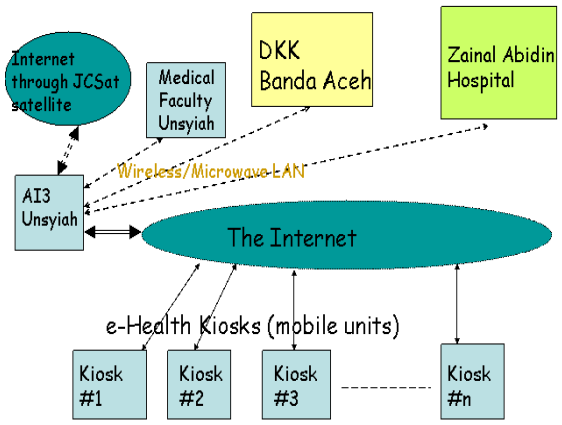
This project is intended to demonstrate how collaboration between developed and developing countries can lead to a successful e-health policy in developing countries, particularly in remote communities. The idea emerged during the International Workshop on Enterprise Networking and Computing in Healthcare Industry (Healthcom2004-technically sponsored by the IEEE Communication Society), held in Odawara, Japan, in June 2004. It is intended to bring together a number of concepts and project results discussed during Healthcom2004 for the benefit of healthcare in the developing world. The project will target distress situations in e-Healthcare based on mobile wireless technology, such as [ITU-D04]:

- Emergency telemedicine
- Epidemic/Pandemic Control
- Bio-terrorism situations
- General tele-healthcare

Although this initiative covers three main types of activities (disaster telemedicine, epidemic control and bio-terrorism), the disaster telemedicine got the maximum attention due to the recent Tsunami. Trials have started in India and Indonesia on the use of Mobile wireless e-health kiosks to support disaster telemedicine. It was also explained that the initiative was based on flexible funding arrangements based on the needs of the target developing countries. For example, Indonesia and India have had completed different sources of funding (a combination of local and international sources including bilateral aid from developing countries and institutions, such as WB, JICA etc).

This consortium has developed the e-health kiosks for deployment in remote locations in developing countries.

Figure 3: Internet-based eHealth System Tsunami Affected Areas



Basically, the movable/mobile telemedicine system consists of at least: one or some fixed central community healthcare units, one or a number of movable/mobile healthcare units (e-Health Kiosks – each with its appropriate power supply units), dedicated PC server(s), existing telecommunication infrastructure with various facilities, the internet access, and the appropriate transport vehicle(s).

E-Health Kiosk prototypes and a dedicated server for the telemedicine system have been implemented (with assistance from various international organizations) for the initial trial. Some basic telemedicine applications include the following:

-Web-based information for the community & medical/healthcare personnel

-Stored & forward patient data recording and reporting system

-Stored & forward tele-consultation and tele-coordination

-Real time tele-consultation

-Real time tele-diagnosis

-Medical tele-education.

-Further derived applications of telemedicine system.

Developing countries are often hit with natural disasters, such as Tsunami leading to massive losses of life and property. Unlike the developed world, developing countries (and their parts) are at different levels of technological infrastructure. The wireless mobile communication technologies offer the potential for developing countries to use recent advances in Internet-based services (e.g., e-health) for efficiently reaching services (e.g., healthcare) to remote regions in their countries. Figure 3 shows the architecture of the mobile e-health systems under trial in the Tsunami-affected Banda Aceh region in Indonesia. E-Health kiosks are being installed in various Puskesmas (primary healthcare centers). These kiosks are being connected to the major hospitals and the DKK (Regional Health Service Headquarters) through a broadband wireless WIMAX network. The main university in Aceh (Unsuyiah) that has a medical college is acting as the gateway between WIMAX and satellite network for external Internet connections.

The kiosks are being connected to main healthcare establishments in Banda Aceh and other parts of Indonesia through the Internet to distribute load amongst healthcare centers. The trials of these e-health kiosks (and other

countries like India) are expected to assist us in proposing a framework for the development and deployment of e-health in developing countries through UN agencies and the WHO [SOEG05]. These trials will evaluate the m-health framework with respect to a number of factors, such as:

Technical

Network architecture, telemedicine devices and their interfaces, software architecture of the applications and interoperability specifications

Functional

Functionality needed with respect to requirements of emergency telemedicine and epidemiology

Organizational

Location of the kiosks, distribution of data and resources, selection and training of personnel, operational guidelines.

V. CONCLUSIONS AND FUTURE WORK

This paper has presented the development efforts on e-Health from the perspectives of developed and developing countries. We have seen the motivations and strategies for e-Health in both developed and developing countries in the context of work being done by various world bodies, such as the ITU, TMA, ESA and WHO. We have also observed the need for multi-organization, multi-disciplinary, collaborative approach to overcome the formidable challenges offered by e-Health.

The importance of e-Health in overcoming the digital divide has been endorsed as follows in the Resolution of the Fifty-eighth World Health Assembly (2005) that has recognized e-Health as the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research and urges all member of the UN to consider drawing up a long-term strategic plan for developing and implementing e-Health services in the various areas of health sectors, including health administration, which includes an appropriate legal framework and infrastructure and encourages partnerships of public and private sector, healthcare and information technologies and international collaborations to address global healthcare problems, such as increasing the coverage of population, pandemic control (e.g., SARS) and disaster management (e.g., Tsunami) [WHOR05].

Therefore, the future success of e-Health (that has potential to overcome the digital divide) is likely to depend on the ability to develop an integrated framework involving technical, organizational, socio-economic and legal aspects of healthcare, and that requires a global, multi-discilplinary, collaborative approach that the future communication engineers need to be familiar with.

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Establishment and Development of an Integral Information System: Five Croatian Innovations

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Authentic Croatian design has materialised in new five project approaches:

1. Central position for a Primary Health Care Information System in the integral health information system

Primary Health Care Information System (PHCIS) – is a key point regulating its effects. Croatian PHCIS has been devised as an integrator of all modules within the health system. One of the basic innovations in the approach to integrating data and information in health, it had been inspired by the concepts of late Professor Stampar who, as the founder of modern primary health care, also regarded primary health care as a link or integrator of the entire health care. A network of modules with a data and information integrator was conceived as the ultimate objective of the development of an Integral Health Information System. There are a number of modules to link up. The PHCIS should be the only module linked with all the other modules (hospital, laboratory, pharmaceutical, consulting specialist, other diagnostic and therapeutic points). In view of the anticipated number of events and transactions in such system, such integrator was assessed to be the most appropriate solution for developing the entire health information system.

2. Evaluation by trial run:

Clearly, a bid for the purchase of Primary Health Care Information System and of an Integral Hospital Information System has been conditioned by the need to meet special requirements that are set before the system. Another important element of the assessment imposed by the bid was to carry out a trial run on real patients, real doctors and real surgeries, which was done in 2003. This is the second innovation and the second element of the "Croatian approach". Involved in the evaluation were the foremost experts in individual areas. The determination was made by an international evaluation jury whose members included World Bank experts, norm and security experts, and public health experts, Croatian Health Insurance Institute, and Ministry of Health and Social Welfare. They all juried each from his standpoint whether the approaches met the requirements. Both trial run and trial run evaluations showed outstanding results. It was a public revelation of bidder abilities, their strengths and their weaknesses. The Faculty of Electronics and Computing, who rated the whole project excellent, evaluated the whole project and the choices made.

3. Choosing a builder, not deliverer:

The bidding did not look for a deliverer of some prefabricated solution, but for an able bidder who would show his ability as a system builder in real time, and on genuine patients, i.e., one who would be building the system and regulating intellectual property rights, hardware and software rights, right of the source codes etc., jointly with its users.

4. Develop a PHCIS that provides at a single point for everyone concerned:

BI (*Business Intelligence*)
PHI (*Public Health Intelligence*)
HCI (*Health Care Intelligence*)
MI (*Management Intelligence*)
KI (*Knowledge Intelligence*),
EI (*Equity Intelligence*), and
II (*Integration Intelligence*)

5. Fool regulation of ownership and rights on hardware, software, source codes etc. Fool regulation of intellectual ownership rights of future users.

Building Clinical Capacity in Africa: The Search for Cost Effective, Scalable Solutions

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The pressing need for clinical skills in Africa to overcome morbidity burden as well as to break the ill health/poverty nexus is mirrored by the potential for ICT as a tool for building clinical capacity. The many projects in place are typically based on affluent western medical models that may not be relevant to the African context. Moving away from such models does not necessarily mean second rate services. Rather, it brings the chance to build accessible clinical capacity that will be appropriated and sustainable. Questioning the fundamental assumptions of what 'clinical capacity' means and how the 'effectiveness' of projects can be interpreted in the African context becomes a project in itself that requires grounded research using indigenous data collection methods. That project is presented here in terms of its methods and preliminary findings.

Keywords: development, economics, capacity, Africa

I. INTRODUCTION: LEADING TO RESEARCH QUESTION

The people of Africa suffer disproportionately from disease (c.f. HIV/AIDS, poverty-related, tropical) and trauma while having some of the lowest ratios of doctors to population in the world (W.H.O, Global Health Trust Human Resources for Health, Hagopian et al., 2004). This mismatch has been recognised as one of the greatest humanitarian disasters in history (various including World Vision).

The insufficiency of clinical capacity is one of the key contributors to the nexus between poverty and ill health that besets Africa. This nexus then impacts on nations' ability to train, attract and keep clinical staff. There are only 87 medical schools in the 47 Sub-Saharan nations: 11 nations have no medical schools and 24 have only 1 (Hagopian et al., 2004). Once qualified, many nurses and physicians leave the continent. Britain, which accepted 3000 African nurses in 2003, has developed a code of conduct to limit poaching clinical personnel from developing nations (DFID, 2004). According to Hagopian et al, the USA continues to facilitate migration by health workers from Africa. Of the 5334 physicians from sub-Saharan Africa practicing in the USA 86% originate from only three countries: Nigeria, South Africa and Ghana (Hagopian et al).

Juxtaposed to this crisis in clinical capacity is the great potential for ICT as a tool for building clinical capacity coupled with a global movement towards humanitarian health outcomes. There are abundant examples of universities, NGOs, hospitals, groups of clinicians, and companies develop systems to build clinical capacity in underserved areas globally. Two such systems are outlined here. One of these is building clinical capacity directly, by training African health workers, the other is building clinical capacity indirectly by enabling access to underserved populations for skilled clinicians working remotely.

- The Nairobi-based, info-DEV funded SATELLIFE project of HealthNet aims to update clinicians' ICT and clinical knowledge in various African nations, especially those that do not have a medical schools. The emphasis is on providing ICT access and training so that clinicians can more effectively access information globally as and amongst themselves as well as accessing the SATELLIFE information packages (including online journals, on line theses, distance education resources, etc). During the infoDEV funding period (1999-2000) 87 clinicians were trained in IT skills and 24 people were trained in ICT train the trainer. Qualitative evidence argues, for example, that the Uganda Ministry of Health has increased the effiency of its use of ICT as a result of key personnel participating in SATELLIFE (infoDEV).
- Two universities in the Asia-Pacific region have a relationship with a Sri Lankan hospital whereby penultimate year med students are flown to Sri Lanka where they follow consultants on their ward rounds to capture digital images of patients that the student thinks require a second opinion. Those images are then emailed back home where they are considered by the teaching staff at the relevant med school. The aims are to provide clinical support to Sri Lanka while providing a learning experience for students. During the pilot phase, the three participating students reported that it had been a maturing experience; 11 images were dispatched for second opinion all of which confirmed the original.

The research reported here was inspired by the array of such efforts and so asks: are they effective? While the ultimate goal of the research is to identify cost-effective methods for building clinical capacity in Africa in order to inform the adoption and implementation of projects, there is a

need to work backwards to basic principles and assumptions before moving forward to solutions. Two fundamental questions addressed here are:

- What do we mean by clinical capacity in the context of African health needs?
- What do we mean by effective in the context of building clinical capacity in the context of African health needs?

II. Method and preliminary findings

The project from which this paper is drawn has multiple stages and uses multiple methods. The stage reported here identifies and queries the assumptions on which the project rests. This stage is essential to good research, good practice and meaningful outcomes and yet is typically bypassed in the rush to get to the field and is typically overlooked in the literature in the rush to get to the findings. By taking this radical route we plan to avoid white elephants.

The method is one of unbundling what is apparent, questioning it from the perspective of the African context and then developing empirical strategies to answer the resultant questions. The methodology is therefore grounded qualitative research (Strauss and Corbin, 1990). The objective being to gain an understanding of the knowledge held by expert participants in the context that is of interest (i.e. African health work). These experts are community members including patients, clinicians, administrators and related authorities. Specifically, we need to gain understandings that will address the two questions about the meaning of 'clinical capacity' and 'effectiveness' in context. Because this work is exploratory (does not have an accepted theoretical or practical approach) we are refining our method in response to our preliminary findings (Yin, 1994).

III. What do we mean by 'clinical capacity' in the context of African health needs?

The lesson from developmental experts (practical as well as academic) is that technologies, process and outcomes must be relevant to the specific developmental context (e.g. Pursell, 1993). From a prosperous, western perspective it is 'natural' to assume that community members need access to clinical skills of a certain standard including both general and specialised; that those clinical skills will be embodied in clinicians (either generalists or clinical specialists) with whom the patient has no other relationship and that the process for accessing those clinical skills will be formalised through clinics and hospitals. The appropriateness of this medical model to African contexts needs to be questioned.

Considering the issue of the standard of clinical skills and associated medical care to which community members 'should' have access is problematic for organisations dealing with underserved communities. A moral dilemma can ensue whereby those intent on doing good realise that they cannot provide specialised obstetric care, for instance, to African women although they would demand it for themselves. While the concept of offering second rate services to those who cannot afford first rate services is not accepted in many western nations, in fact is the raison d'etre for national health insurance (Preker et al 2002), extrapolating this to the African context may not be appropriate. In societies in which the naturalness of child birth is celebrated, the involvement of specialist obstetricians with their reliance on interventions may be an inappropriate westernisation.

The challenge then becomes to understand what clinical standards are appropriate to specific locations. For this there is a need to have organisations currently working in the field, as well as community members more broadly, inform on what is appropriate. The ideal method for such expert input on a complex issue that requires deliberation is the Delphi (Delbecq, 1975). While some of this work could be done remotely using ICT mediated Delphi methods developed by Francis, Firth and Mellor (2005), much of the work needs to be done using observation and discussion methods common in ethnographic studies as modified for indigenous research (Ho, 1998). We should not assume that because of their colonial pasts and their contact via TV that African communities and their members are open to our medicine or our research methods.

The question as to the appropriate embodiment of clinical skills is similarly fraught with western medical model assumptions. The concept that clinical skills should be vested in a clinical expert (generalist or specialist) is a western medical model that pervades many of the current projects to build clinical capacity, including the two examples above. Historically, there seems to be both centralised and distributed models of 'medical' knowledge (Selin, 1997). Most cultures, favouring centralisation, have had skills the demesne of wise-women, priests, priestesses and other particular community members. Other cultures have favoured a distributed system whereby households took responsibility for their own. While working with traditional relationships has apparent advantages, ICT mediated capacity building projects tend to work with clinical expertise. This is understandable given that they want to take advantage of existing clinical knowledge.

The choice of embodiment will impact profoundly on the systems for building clinical capacity. Obviously, building distributed clinical capacity across entire communities would need different systems from those for building concentrated clinical capacity, possibly amongst already qualified workers. If a centralised model is to be adopted, the issue as to the characteristics of the person in whom the knowledge is to be vested, and their relationship with the community must be considered (Fishbein, et al 1975). As Rogers (1962) argued in the famous case of Peruvian villagers' adoption of water boiling, inappropriate 'agent' selection can destroy a program's credibility. Therefore, it is necessary to choose carefully the persona of the agent in whom to vest clinical skills. In a society in which all health knowledge is believed to be held by old women, for instance, it may be unworkable to have the 'face' of learning to be a young, white man from the city. Similarly, in a society in which early 'medical' knowledge is gained dialectically between elders, it may not be unwise to assume the easy and rapid appropriation of ICT as the medium.

The issues of the relationship between the person with clinical skills and the community members, and the process

by which community members access clinical skills are similarly in need of investigation. The relationship between community members and the expert other with clinical skills in the western medical model may have much in common with traditional centralised model relationship between community members and the mystic/wise other. The distributed model of embodiment creates a different set of relationships and processes for access by community members. While these issues are tangentially related to the process by which clinical capacity will be built, it is important that they be understood in order to ensure that the model of appropriate standard and appropriate model works well with the community's dynamics. If this is not the case, the wrong questions may be asked and answered. In similar vein, the question of funding of both the capacity building capacity and of accessing that capacity by the community needs to be resolved. To some extent, that issues is addressed in the next section.

IV. What do we mean by 'effective' in the context of building clinical capacity in the context of African health needs?

The ultimate objective of the program to build clinical capacity in Africa must be the better health of the populations and the associated amelioration of poverty. Because poverty and health outcomes have internationally agreed-upon measurement criteria, and because those measures are in place now, not only could eventual states be measured, but those eventual states could be compared with the current state to identify the effect of the program. Unfortunately, neither of health nor poverty outcomes can be operationalised due to the length of timelines and the complexity of intervening factors. Therefore, there is a need to identify other objectives and set appropriate criteria that are consistent with the intention of the project, can be assessed (qualitatively or quantitatively) and which can be expected within a reasonable timeframe.

Consistent with our arguments as to the need for appropriate understanding of the 'clinical skills', we argue here that it is important for the criteria for effectiveness to be appropriate. One of the fundamental principles of economics is that benefits can only be understood in terms of utility (e.g. Deaton and Muellbauer, 1980) from the perspective of the 'consumer'. Therefore, we must ask, what criteria would be consistent with the African individuals' and communities' perception of benefit? To answer this would requires considerable grounded research using methods comparable to those set out above.

It is likely that benefits would ensue from access by community members to clinical skills in the 7 diseases and conditions that account for the bulk of the burden of morbidity in Africa (including diarrhoea, tuberculosis, traumatic injury, maternal and child mortality, malaria and HIV/AIDS) in order to prevent, diagnose and treat. This access could be direct to health workers or indirectly via ICT, either way it is the access to the skills that has the potential to bring benefit.

The criteria for existing projects do not always deal with issues of access to clinical skills by community. Unfortunately, many of the projects have not established identified criteria, did not establish a base case and are not planning to measure outcomes other than throughput. The criteria for success gleaned from our early analysis of the projects include the following (because this section may seem to be unfairly critical of projects that we have not fully analysed, their criteria are anonymous and general):

- Number of doctors/nurses undertaking the course – organisations that offer professional development to those with clinical qualifications (often universities and teaching hospitals) often count the number of enrolees, those who complete the course, or those who pass assessment. No evaluation of the link between advancing skills and health outcomes or access by community.
- Number of cases discussed
- Number of emails sent and to some extent their content
- Number of home students involved
- Portability of qualifications – while presented as an aid to African health workers seeking a better life abroad, given the arguments of Hagopian et al, and others above, this criteria can also be seen as a prelude to poaching.

Because poaching is such a drain on Africa's limited clinical capacity, this project takes as a working assumption the idea that to be effective any clinical capacity building must deal with the issue of qualification portability head on. Therefore, we are currently developing methods to identify ways to build clinical capacity that is at once appropriate to the contexts in which it will be applied, and is not readily poachable by developed nations. Pragmatically, we will work iteratively with health sector employment regulations in the top 10 poaching nations and the expert informants in African communities to develop options.

V. Conclusion

Thus, this first preliminary stage of the project involves an holistic, iterative approach of questioning the fundamental assumptions and working with communities to gain insight into what capacity building will yield them health benefits. Once this is clarified, we will be in a position to apply a budget overlay to identify ways to build that capacity cost-effectively.

Because the need for clinical skills in Africa is so great and the potential for ICT as a tool to build that clinical capacity is so promising, there is a tendency to jump in with projects. Many of those projects are founded on assumption more consistent with prosperous western medical models than with contextually-based assumptions related to standards and effectiveness. The outcome can be skills that are not appropriate, accessible or sustainable due to cultural clashes, inappropriate interaction models and poaching.

The method set out here, while arduous and laborious, takes a radical approach to developing the level of understanding necessary to build clinical capacity that can break the poverty/ill-health nexus in Africa.

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On the Horns of a Dilemma: Telemedicine for Africa?

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Abstract- Telemedicine is proposed as a solution to many problems of healthcare delivery to disadvantaged communities and countries. Is telemedicine a practical solution for Africa? Africa is faced with the triple burden of disease, tuberculosis, malaria and HIV/Aids, exacerbated by poverty. Despite this, it is projected that the population of Africa will more than double by 2050. There is a shortage of doctors in sub-Saharan Africa with 30 of 47 countries having less than 10 doctors per 100,000 people. The gross domestic products (GDP) of sub-Saharan African countries are significantly less than those of the developed world and African countries allocate a smaller percentage of their GDP to Health - many African countries allocate less than $10 per capita per annum to Health. Africa is not in a position to buy international telemedicine services from the developed world. Simple solutions, like store and forward telemedicine are also not cheap, with the average cost of internet access estimated at $68 a month in Africa vs $22 in the USA. Even at the level of email, there is the risk of the cost of the service jeopardizing healthcare, if ICT infrastructure is funded from Health budgets. Technical standards are also an issue. Is an email service based on digital photographs of X-Rays, which do not meet international standards, unacceptable, or is something better than nothing? What are the ethical implications of lowering standards? Are there any solutions for Africa? What is required are innovative approaches to the development of new financial models for international telemedicine, new standards and ethical guidelines for the practice of telemedicine in developing countries and new paradigms for the provision of medical education across international boundaries.

I. Introduction

Telemedicine is being proposed as a solution to many problems in providing adequate healthcare delivery to disadvantaged communities and countries. The concept of telemedicine is alluring, for here we have a means of bringing medicine to rural areas, saving patients' transfers to referral hospitals for second opinions or specialist diagnosis, while also providing a means for doctors in rural areas to be supported by their specialist colleagues. While there is much to commend telemedicine, is it a practical and economically viable solution for developing countries and sub-Saharan Africa in particular? In attempting to answer this we need to look at basic issues relating to healthcare supply and demand.

II. Supply and Demand

A. Demand for Medical Services

Demand is driven by the burden of disease and the effect that this will have on both the population and the healthcare worker. Supply relates to both the provision of doctors and other healthcare workers to service the demand, and the economics related to healthcare budgets.

Africa faces the triple burden of disease, tuberculosis, malaria and HIV/Aids, which is exacerbated by poverty. It is estimated that there are now about 40.3 million people in the world infected with the HI virus, approximately two thirds of whom are in sub-Saharan Africa [1]. Malaria claims over a million lives per annum and 90% of all malaria deaths occur in sub-Saharan Africa [2]. In the absence of a cure for HIV/Aids and facing the reality that many HIV positive patients are unlikely to have immediate access to antiretroviral therapy in Africa, there will be large numbers of people dying at a relatively young age. Together with malaria and TB, what is the effect of this going to be on the population of Africa?

The population of Africa is currently about 906 million people. The United Nations Population Division, in its 2004 revision, predicts that the population of Africa is going to more than double, to 1.937 billion people by the year 2050 [3]. So for the foreseeable future there will be many people dying of AIDS, malaria and TB and a growing young population. Does Africa have the capacity to manage the healthcare of this growing population?

B. Supply of Health Personnel

Compared to the developed world, sub-Saharan Africa has relatively few medical schools, with 1 for every 7.6 million people, whereas the USA has 1 for every 2.1 million people [4]. African medical schools do not all produce large numbers of graduates and there is the ever present "brain drain" of doctors from Africa to the developed world [5].

Italy	606	South Africa	69
USA	549	Nigeria	27
Canada	209	Zimbabwe	7
Egypt	211	Uganda	5
China	164	Malawi	1

TABLE 1

Number of doctors per 100,000 population.

Reliable recent data on the number of doctors in African countries are sparse. Some examples of the number of doctors per 100,000 population in various countries are given in table 1 [6].

At the top end of the scale, Italy has over 600 doctors per 100,000 population. Canada, which could be taken as a bench-mark, has 209. In Africa, Egypt leads the way with 211. The picture for sub-Saharan Africa is somewhat different. South Africa has 69 doctors per 100,000, followed by Namibia with 29. It is sobering to note that 30 of the 47 sub-Saharan African countries, for which there are data, have less than 10 doctors per 100,000 people [6].There is therefore a major shortage of doctors in Africa. Associated with this is a similar shortage of nurses and other healthcare workers. While South Africa appears well supplied when compared to the rest of sub-Saharan Africa, the picture is less rosy in the State sector which services the 70% of the population of South Africa. In the Western Cape Province there are 14 specialists per 100,000 population, in KwaZulu-Natal 6, and in the Northern Cape Province only 2 per 100,000. One of the benefits of telemedicine is supposed to be that scarce skills can be shared with rural areas. Is telemedicine a possible solution to the problem?

III. Health Budgets in Africa

A. Health Budgets

Currently, the existing models of telemedicine are largely based on a first world fee for service model or are NGO donor funded projects. Is Africa able to buy international service and thus buy itself out of its shortage of doctors? The gross domestic product (GDP) of several countries is shown in table 2.

Not only are the GDPs of sub-Saharan African countries significantly smaller than those of the developed world, but African countries also allocate a smaller percentage of their GDP to Health. The multiplicative effect of this is apparent. African countries spend less per capita on health than those in the developed world with 25 countries spending less than US$10 per capita per annum. With health budgets at that level it is not possible to purchase a telemedicine service from the developed world.

TABLE 2
Gross domestic product (GDP) per capita of several countries in US$, the % of GDP spent by government on Healthcare and the amounts, in US$, that governments spend per capita on Healthcare.

	GDP US$ Per capita	Health Budget % GDP	Health Spend Per capita US$
USA	37,648	6.6	2,485
Canada	27,079	6.7	1,814
Australia	26,275	6.5	1,708
South Africa	3,489	3.5	122
Kenya	450	2.2	10
Nigeria	428	1.2	5
Burundi	83	0.6	0.5

One could argue that if an adequate telemedicine infrastructure is established in a country, this would lead to an improvement in the provision of services. It needs to be remembered that what telemedicine does in the first instance is to increase workload; as one doctor's problem now becomes that of another, already overburdened doctor, when the patient is referred. It can be argued that in the longer term, there is a potential learning benefit and the referring doctor should learn from the referral process and ultimately need to refer fewer cases. There are many examples that show that the provision of infrastructure does not guarantee a functional, sustainable telemedicine service.

B. Infrastructure and Connectivity Costs

There are other problems relating to infrastructure. Information technology comes at a cost. Not only is there the cost of purchase, but also the ongoing cost ownership. Simple, apparently cheap solutions like the use of email are not necessarily so simple or cheap in Africa. While every country in Africa has email and web access, the points of presence of independent service providers are often only located in capital cities or large cities [7]. This means that doctors in rural areas have to incur the cost of a long distance call to be able to send an email. It has been estimated in 2002, that the total cost of 20 hours of dial-up internet, access, plus internet subscription fee, was US$22 per month in America. In Africa the average cost was estimated to be US$68 per month [7]. Relate this to the healthcare spend in some African countries, table 2.

Even at the level of an email service is therefore the risk of the cost of the service jeopardizing healthcare, if IT infrastructure and use is to be funded from Health budgets. Obviously costs increase as real-time options using dedicated tele-diagnostic instruments and videoconferencing are used. African nations do not have a good track record when it comes to telecommunication legislation and roll out, and bandwidth remains, and will continue to remain a major problem.

It is hoped that cellular phone technology, wireless solutions and the promise of greater access to satellite communication over Africa will improve the situation. At the end of the day however, one needs to be confident that the cost of ownership of telemedicine infrastructure and its use will not result in medicines being taken out of the mouths of sick children.

IV. Standards and Ethics

Another problem area for telemedicine in Africa is that of technical standards. The present standards have been developed in a litigious first world setting. Obviously a radiologist in Boston seeing a digital X-ray referral will have to demand an image that is as good as the image that would be generated by conventional radiography - for an error made from reading an X-Ray of inferior quality could be costly. The DICOM standards are therefore high.

The dilemma of image standards in the developing world setting is twofold. Some of the X-Rays taken in rural hospitals are not of the best quality and flat bed scanners that can scan an X-Ray to DICOM standards are expensive and produce images of megabyte size. These large files are difficult to obtain and send by email, especially if electrical supply and phone lines are not stable. The compromise is to use a digital camera to take a picture of the X-ray and to send the much smaller JPG image of 100 to 500 kilobytes in size [8].

This practical alternative raises the problems of confidentiality and data security. Ideally, any patient information transmitted over the internet should be suitably encrypted so as to ensure confidentiality. While there are suitable shareware solutions available, like Telemedmail, which use the worldwide web to distribute the emailed cases, the reality is that even in the KwaZulu-Natal in South Africa, the system cannot be implemented because doctors in rural hospitals do not have web access in their hospitals and many have to use their own dial up accounts after hours to send cases.

The question therefore is, is a less than ideal service, using images of lower standard, sent by unencrypted email, unacceptable, or is something better than nothing? The ethical and legal issues of accepting standards below the international norm also need to be faced and addressed?

V. THE WAY FORWARD?

The question must be asked again as to whether telemedicine is a viable proposition for Africa? We know that telemedicine in its various forms can be practiced in Africa. In our experience in KwaZulu-Natal, store and forward telemedicine has proved useful in radiology, dermatology, ophthalmology, orthopaedic and plastic surgery and we also regularly use ISDN line based videoconferencing for tele-dermatology between larger cities. ISDN and ADSL lines are not available in the smaller towns and rural areas of South Africa and this therefore precludes widespread implementation of synchronous telemedicine. Even with adequate funding, lack of bandwidth will continue to be an obstacle to the provision of telemedicine in Africa. Wireless solutions are limited and satellite communication is too costly.

What can be done to address the shortage of doctors? There are several potential solutions. One is to utilise the skills of doctors already in the state sector. What we have found is that some departments have embraced telemedicine and see it as a way of reducing unnecessary transfers, thereby reducing their outpatient loads while at the same time educating the referring doctors and reducing the ultimate number of referrals. Another option is to recruit doctors who have retired but who would like tocontinue to offer a service in their own time. This can be extended to retired doctors on other continents, once the legal and ethical issues are resolved.

Another solution is to go to where there is an oversupply of doctors. But, as has already been mentioned, how will Africa purchase this service? This could be done by accessing donor funding to purchase service, but obviously this is unlikely to be sustainable. What is needed is a different model. It has been suggested that international service could be modelled on international centres of excellence. The potential problem with this model is that centres of excellence will tend to want to attract international patients at international fees. Another international model looks at using spare capacity in a 'barter model' in which Africa barters its wealth of clinical material, for service. This needs to be explored further.

The shortage of doctors in Africa also means that there is a shortage of doctors to train doctors and this especially so in the medical and surgical specialties. Innovative approaches are required to distribute and share medical educators and teaching materials in a manner that teaching is appropriate to the regional diagnostic and treatment algorithms which are themselves dependent on both national and regional government budgets.

This paper does not attempt to offer ready solutions to the problems facing healthcare delivery in sub-Saharan Africa. Rather it aims to make international donors and partners aware of the obstacles that face the practical implementation of telemedicine in Africa, so that together with their African colleagues, relevant practical solutions can be found, to the benefit of the neediest, the rural poor.

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Session 9

International Ubiquitous Healthcare (u-Health) Initiative

International Initiative for Ubiquitous Healthcare (U-Health)

I. Introduction

Current and future information technologies offer great potential for the society to quickly adopt e-enabled services for economic and social development. Some countries in Asia, such as South Korea and Taiwan, are leading the world in the coverage of broadband services, where almost 75% of the population have access to broadband services. Hence these countries are in a position to demonstrate to the world various e-business services (and their impact) based on broadband wireless mobile technologies.

e-Health (healthcare activities based on Information and Communication Technologies) is probably the most prominent of these e-business services that can have a major visible impact on the development of the society, as endorsed in the World Health Assembly in May 2005. Ubiquitous Healthcare (u-Health) focuses on e-Health applications that can provide healthcare to people anywhere at anytime using broadband and wireless mobile technologies. This document gives a summary of a new international collaborative initiative conceived as part of the future activities of IEEE Healthcom, which brings together academia and industry healthcare and information technology professionals to facilitate interdisciplinary collaborations for the development of humanity's future good. Healthcom2007, to be held in Taipei, will showcase some major u-health applications.

II. Main Goal

This initiative is intended to demonstrate how collaboration between countries can lead to successful u-health applications. The goal of Healthcom2007 is to bring together a number of concepts and project results discussed during Healthcom2005 (hosted in Busan, South Korea) for the benefit of ubiquitous healthcare in the world. It may be noted that the world's increasing ageing population necessitates concentrated research on healthcare paradigms beyond the current hospital-based healthcare regime because the hospitals (which are already stretched to limits) will not be able to handle the increase in ageing population. In addition, the increasing percentage of chronic illnesses requires a pervasive effort to increase the awareness of all concerned on how to lead a healthy life. The initiative will target programs and projects related to various aspects of u-health, such as:

- u-Health Systems Development and Application
- Studies on the Impact of u-Health
- Models for integrating u-Health in governance and business processes
- Paradigms for Promoting Healthy Life with the help of governments and businesses

III. Expected Results

This initiative will show case cutting edge technologies and their impact on health promotion and healthcare services in the context of u-health (healthcare based on broadband and wireless mobile technologies).

IV. Partner Countries

- Australia
- France
- Greece
- Korea
- Taiwan
- USA
- more to join …

V. Funding Mechanism

Each participant country will develop research programs (for sharing the experience with partners of this initiative) under this theme based on local resources and international collaborations.

Individuals, corporations, and foundations interested in making a philanthropic investment in this new initiative program may contact:

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Session 10

Electronic Health Records and Data Transmission

Electronic Health Record in Continuous Shared Dental Care

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The European Centre for Medical Informatics, Statistics and Epidemiology (EuroMISE Centre) is the joint workplace of Charles University, Academy of Sciences CR, two hospitals and University of Economics. The EuroMISE Centre focuses on new approaches to the electronic health record (EHR) design. The participation in European projects as well as the CEN TC 251 standards and the cooperation with physicians have produced much experience, which helped to develop a pilot EHR system called MUDR (MUltimedia Distributed Record) (Hanzlicek, 2004), (Hanzlicek, 2005). It is based on the three-tier architecture with an unusual data-storing approach based on so-called knowledge base and data-file principles. Within MUDR development an extra branch was separated simplifying both the MUDR architecture and the MUDR data-storing principles. It creates the MUDRLite EHR (Spidlen, 2004) application, which can be without problems deployed to a particular environment.

One of pilot applications developed within this applied research is the MUDRLite universal EHR system. To gain MUDRLite's user-acceptance in the field of dental medicine we have developed a high-advanced component representing the dental cross, which is a crucial part of medical documentation in dental medicine. So called DentCross component will be described in more details. The data model of this component originates in the so-called Dental Medicine Data Structuring Technology Using a Dental Cross. This technology was applied by the authors of this paper for a Czech national patent under the No. PV 2005-229. First applications of the DentCross component were developed in

the papers (Teuberova, 2005) and (Spidlen, 2005) with the support of the grant no.1ET200300413 of the Academy of Sciences CR.

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Keywords: Electronic Health Record, Dental Medicine, Data Model, Medical Informatics

Implementation of a Computerized Information System in Oncology Unit

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Oncology Unit (Sotiria Hospital, Athens, Greece) has implemented a computerized information system that consists of three modules: the EPR module, the image archive module and the lab module. The EPR module is a database application that stores clinical results, physician orders and some administrative data. The image archive module is used mainly for the reduction of images volume. Finally, the lab module includes information about the patient blood samples and additional data that need to be kept along with each blood sample. All these modules communicate through EPR module. Key physicians, biologists and secretary personnel are involved in data entry and information management; the system administrator is responsible for the system functioning. Data security and confidentiality policies are followed to assure the maximum level of system reliability. Finally, the main target of this system is to enroll computers in Oncology Unit's daily practice and change the paper-based status quo.

I. Introduction

Health informatics is one of the fastest growing areas of information and communication technology (ICT). It is a multifaceted field concerned with electronic patient records, image processing, computer aided diagnosis, research support, database archival and hospital management. Despite the remarkable barriers to adoption there are significant technical, legal, economical, professional and cultural reasons for the growth of such systems. The potential benefits of their adoption in the hospital environment are obvious. In parallel, their use should ideally promote and must certainly not be in conflict with the fundamental medical ethical principles.

Generally, healthcare information systems have to guarantee quality and efficiency of the medical maintenance. In the clinical work processes the handling of huge amounts of information is a very important issue. Without structured analysis and communication of clinical information it is not possible to achieve crucial goals in specific areas of healthcare [1]. This is extremely important in the case of caring a cancer patient. The cooperative care for cancer patients (declared as "Shared Care") requires a complete, distributed cancer documentation, summarized in clinical cancer records [2].

One of the mostly discussed issues between health informatics professionals is Electronic Patient Record (EPR). Generally, EPR is an indicator of the progress in health informatics domain and allows providers, patients and payers to interact more efficiently and in life-enhancing ways. It offers new methods of storing, manipulating and communicating various types of medical information that characterize it as more powerful and flexible compared to paper-based systems. Usually, EPR systems are not stand-alone but enhance a variety of add-on components according to the specific requirements of each environment.

Following the demands of the new era, the Oncology Unit of Athens Medical School (Sotiria Hospital, Athens, Greece) has implemented a computerized information system that consists of three modules: the EPR module, the image archive module and the lab module. These modules are tightly integrated. The system administrator is responsible for system operation, its security and users training. The system and the users involved are briefly presented in Figure 1.

The main target of this system is enrolling computers in daily clinical practice in order to provide qualitative healthcare to cancer patients.

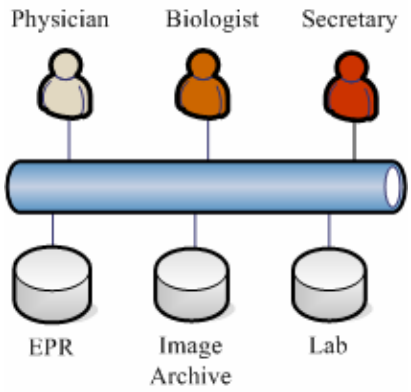

Figure 1. Unit's computerized information system.

II. System Modules

A. EPR module

The core of this computerized system is Electronic Patient Record module. EPR module is a relational database which is accessed by the end users through a friendly interface. EPR data include clinical results (laboratory results, procedures) and physician/patient care orders (orders, requisitions, consultations). Also, it includes administrative data such as admitting diagnosis, patient location and follow-up appointments. All EPR data are linked to a unique Patient Record Number (PRN). The EPR module is used to produce reports, organize data and provide immediate feedback to important questions.

Data are retrieved from the database using various forms. First of all, there is a welcome screen with a few command buttons that allow user navigating the other forms. For example, there is the 'Patients' button, that opens the form presented in Figure 2. In this form the user is able to navigate through a variety of patients' data (e.g. diagnosis, type of diagnosis) and/or view the other EPR forms (e.g. 'Therapies' form) by clicking the corresponding button. Additionally, there are search and printing options available. The supported language for this module is Greek.

The Unit secretary is responsible for data entry under the guidance of the supervising doctor. The source of data is the existing paper-based record which is kept in the Oncology Unit. As appears in Figure 2, the amount of data imported in each form is not huge and the included information is well-organized. The main idea is that EPR module should not be a copy of the paper-based record but a summarized description of patient's status.

A. Image archive module

The need that led to the development of image archive module was the reduction in image volume, in order to free space in Unit's archive. Naturally, there were additional benefits of equal importance. The module contains two categories of images.

The first category is parted from digital images (CTs, X-rays, etc) that patients deliver to the Unit immediately after their acquisition. Since there is no need for further process, these images are stored in the archive at once. The rest of the images are film-based that have to be digitized firstly and then imported in the archive module. For this task a film digitizer (Kodak LS40) is used. The images of each patient are stored according to his PRN and can be accessed through the EPR module.

The software program that controls the digitization process is presented in Figure 3. Using this program, the user sets the scan parameters (image analysis, image format etc), selects the archive file and scans the films. In case there is a problem during the scan process, the system produces an error message and the process is interrupted. Normally, a success message is produced.

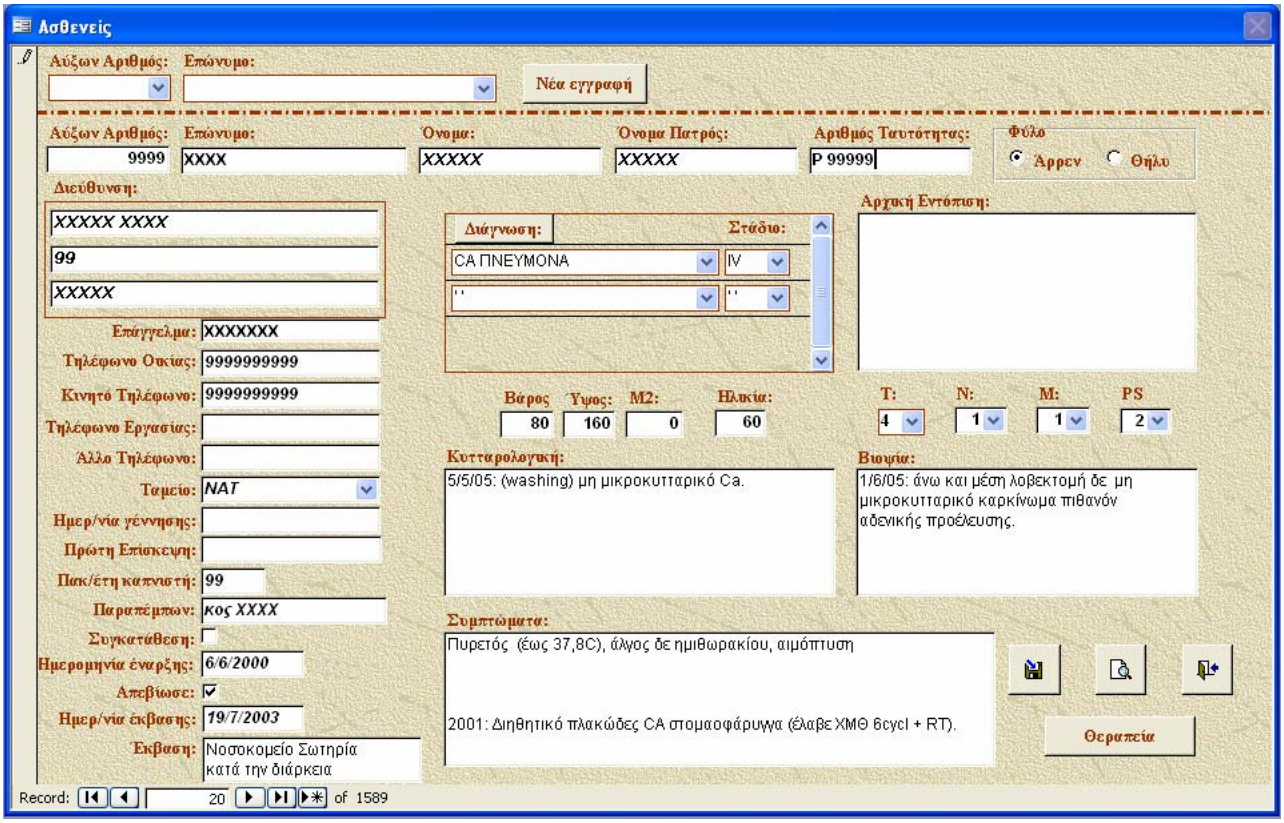

Figure 2. Part of EPR module. User is able to enter various data (personal data, diagnosis, type of diagnosis, symptoms etc) through a friendly interface.

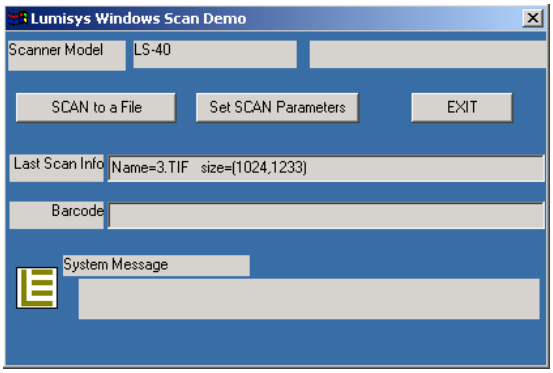

Figure 3. Image digitizing. User sets the parameters and then scans the film-based images.

This program produces either DICOM images or images in TIFF format. In our case, DICOM format is used. Moreover, the patient data included in DICOM images are integrated into the EPR module.

B. *Lab Module*

Finally, the lab module is a simple relational database and stores information about the patient blood samples that are kept in the laboratory. Additionally, it stores data about the patient chemotherapies (cycle, disease etc) that need to be kept along with each blood sample (Figure 4). As in the other two modules, all records are stored according to PRN and can be accessed through EPR. Lab module is very useful not only for the biologists' routine but also for the physicians who are in charge of research projects.

The user is able to perform simple and advanced search for samples, depending on predefined or chosen criteria. Moreover, various reports are produced according to the given criteria.

C. *Users*

Key physicians, biologists and administrative personnel are involved in data entry and information management in all modules.

Specially trained administrative personnel extracts data from paper-based records and subsequently enters them into the EPR module. Data entry is performed in daily basis; when a patient leaves Oncology Unit his personal record (paper and electronic) is updated the same day or the day after. All physicians verify the extracted data and control the whole process for its reliability. Regarding image archive module, secretaries perform image digitization. Finally, biologists are responsible for data entry in the lab module.

Naturally, the system administrator is responsible for the flawless functioning of the system. Administrator is a health informatics specialist and is also confronted with the training of the staff.

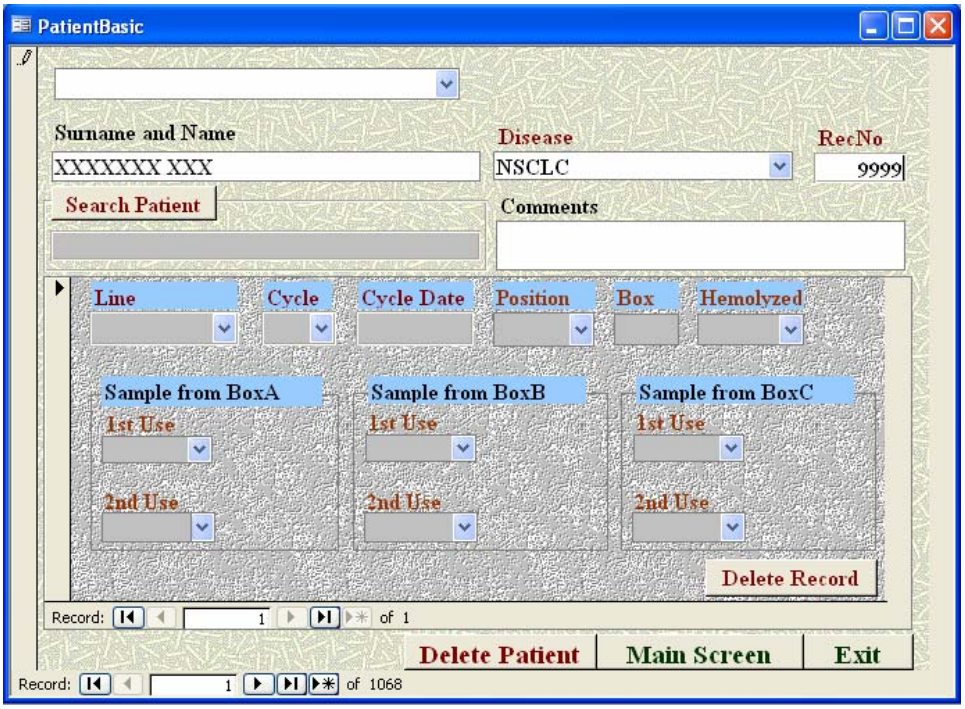

Figure 4. Lab module. All records regarding patient blood samples are stored according to PRN and can be accessed through EPR.

III. Discussion

In oncology, computers may offer great help in data recording for the treatment of cancer patients and in providing support to clinicians for the therapy process. The

collected data are suitable not only for patient care but also for quality assessment, research and management. In order to achieve these goals we have to assure the best data management. This need is quite obvious in an Oncology Unit, a demanding environment, where there is information overflow and increased pressure for immediate decisions.

There are many reasons for using a computerized information system in oncology that deal either with quality of care or with efficiency. First of all, when using a computer system, voluminous amounts of data can be stored; these data can be easily retrieved and analyzed when necessary. The access to structured and well-organized data offers to the healthcare professionals a better insight into the patient's condition and improves treatment. Moreover, the data collected in a computerized system can be easily used for research purposes.

The paper-based data management is still a reality. Many hospitals retain such records as the main source of patient data. Generally, this is the case for Sotiria Hospital where Oncology Unit is established. Consequently, to assure the completeness and accuracy of the EPR module, many data are entered from the paper-based record that works as a source.

It is true that the modern radiological equipment yields images in digital form but the time of film-based radiology has not yet come to an end. Additionally, although the application of PACS (Picture Archiving and Communication Systems) is spreading, it is not always possible to access them. Moreover, image procedures (CT, MRI, PET) do not take place at the same radiologist for all patients. Usually, each patient carries his images when visiting a hospital and delivers them to his physician. Then the physician stores the images at the clinic.

The situation described above causes the enlargement of image volume that leads to storing and accessing problems. Even though that Oncology Unit had a well-organized film-based image archive, we faced these two problems in a very short period of time. Consequently, the image archive module is used for two purposes: the reduction of images volume and the immediate access to them. Since all images are stored in the image archive module, there is no reason to keep them in the Unit in both formats (digital and film-based). After their storage, the patient receives the original images and keeps them in his personal record.

Laboratory is one of the first areas in healthcare where computers were introduced. Computers support the entire process from sample collection to final report generation and validation. Apart from this process, oncology laboratories perform additional tasks. The most important task is the storage of patient samples in low temperature for future analysis. The numerous samples have to be well organized in order to avoid misusing or loosing them. The lab module maintains data about the patient blood samples that are stored in the laboratory. The basic advantage of this module is the offering possibility for immediate access to specific samples, using the search facilities of the module. Moreover, the user is able to categorize samples according to patients' disease or other specific research-targeted criteria.

At this point it should be mentioned that all users are able to access the modules through the local network. Even though each module serves different purposes they work all in one. Specifically, through the EPR module the user is able to access each patient's images and information about his laboratory samples.

The spreading application of computers increases the accessibility of data, especially when various techniques are applied. Unauthorized use of data is not an illusory danger. Therefore, the access to these data must be regulated. The fact that only authorized users should have access to the data is a logical consequence of the right to privacy. The privacy sensitivity of data is strongly context dependent. Data on various diseases are often considered to be extremely sensitive. Oncology data are categorized as such. In our case data security and patient confidentiality policies are followed to assure the maximum level of system reliability.

In order to reduce the threats concerning data confidentiality, integrity and availability some basic methods were used. Regarding confidentiality, all modules are password-protected; the passwords are changed often by the system administrator and are available only to the involved users. Moreover, the equipment (computers, scanner) is under close surveillance and locked when it is not used, in order to assure physical security. Concerning integrity, data are backed-up at the end of each week. Naturally, database modules enhance various security mechanisms for referential, logical and entity integrity. For example, each patient receives a unique Patient Record Number (PRN) to avoid duplicate values.

A quite important aspect of this system that should be noticed is user satisfaction. The importance of screen design and layout of the system [3] is highly correlated with screen design. For this purpose the developed modules were built according to simple and user-friendly methods and user has a very small volume of data to type.

Finally, the economic impact of the described computerized approach is very important. Regarding images, it is obvious that as cost-effective storage media capacity increases, so will the temptation to store all images digitally. Moreover, the extraction of the appropriate data not only improves healthcare but also saves time in physicians' daily practice. As a result, Oncology Unit invests the saved working hours in other activities without spending extra funds.

IV. CONCLUSIONS

Despite the remarkable barriers to adoption, the use of computers is growing. A variety of healthcare applications are developed in order to cover the demands of the new era. It is obvious that Health Informatics field is growing fast. Some healthcare areas, such as oncology, may gain important benefits.

Using the developed system, we intend to manage patient data in a more beneficial way. Apart from this, the collected data could be used in other applications as well. For example, the digitized images could be processed and studied further.

Generally, the field of oncology demands new computerized ways of data management. It is clear that computerized systems may open unexpected paths to new directions.

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Image Shark – PACS-CBIR Integrated System with Interactive Image Transmission Using JPEG2000

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Picture archiving and communication systems (PACS) are designed to provide the radiologist with image information he needs. Currently, state-of-art standard of digital imaging and communication in medicine (DICOM) gives only alphanumerical descriptions of image and this is the only information used in PACS to select relevant images [1]. However, it is industry standard now, textual descriptions are insufficient to describe variety of details in medical image. The content-based image retrieval (CBIR) systems could support DICOM-based retrieval systems and fulfill "right time, right place" paradigms.

In our work we developed Image Shark - a content-based image retrieval system based on Flexible Image Retrieval Engine (FIRE), integrated with PACS solution in one, fully-integrated environment, with novel JPEG2000 codec for effective image transmission and interactive communication. Our system joins classic PACS with content-based image retrieval engine. Such approach gives very flexible and effective image retrieval ways. A set of image- and wavelet-domain based indexes were implemented, verified in initial experiments and selected as suitable for mammograms, radiograms, CT exams and other modalities. Reference medical image databases were used in the experiments (DDSM, IRMA, other datasets from Warsaw hospitals). Precision of data retrieval was comparable with other engines (IRMA, others), giving very promising results with similar or better precision level.

I. INTRODUCTION

Medical images contain vital information about patient state. This information can be used to make diagnosis and to facilitate therapeutic and surgical treatments. Traditionally, these images are stored on films. During the past couple of years, development of digital technologies dramatically changed the approach. Some of the digital imaging modalities include computed radiography (CR) and digital radiography (DR), computed tomography (CT), magnetic resonance imaging (MRI), ultrasound and microscopic imaging (MI). The typical hospital is able to produce gigabytes of image information per day and terabytes per year. Effective management of these huge image databases requires archiving and communication system (PACS) [4]

Health information systems intend to present the right information at the right place and at the right time to the user [1]. Huge labors have been made addressing the right-place- and right-time- paradigms: ultra-fast networking, complicated data storage, high quality displays. Current communication protocols such as HL7 and DICOM consist of standardized textual descriptions of study, patient, body region examined, and technical parameters related to the imaging device and modality.

Although a PACS relies on complex, probably a bit overwhelmed protocols such as DICOM, image selection within a DICOM network is based currently on alphanumerical information only. However, information contained in medical images is much more complex than that residing in alphanumerical format. The reasons of that are various, but as a result the information provided by DICOM structures is not enough to find image data efficiently [2].

The problems with textual description of visual information lead to the idea of using visual-based (i.e., content-bases) indexing and retrieval methods might have a great influence on effectiveness of PACS systems.

By means of uniform protocols and the API provided by the PACS core, this integration can be realized to satisfy the right-information-paradigm maintaining the autonomy of both components, the PACS and the CBIR system. [1]

The other problem related to modern PACS and image databases in general, is efficient communication access to large amount of data. The JPEG2000 standard describes effective tools for progressive and interactive image data transmission in medical imaging applications: PACS-RIS-HIS enterprise, telediagnosis and CAD utilities. However, optimization of wavelet data transformation, selection and stream forming procedures can significantly improve standard implementations available nowadays in the market. Diagnostic quality enhancement and accelerating coding process of applied compression tools can actually improve image-oriented real-time diagnostic systems [9].

Original contribution of our work is an experimental PACS system, with additional support of content-based image

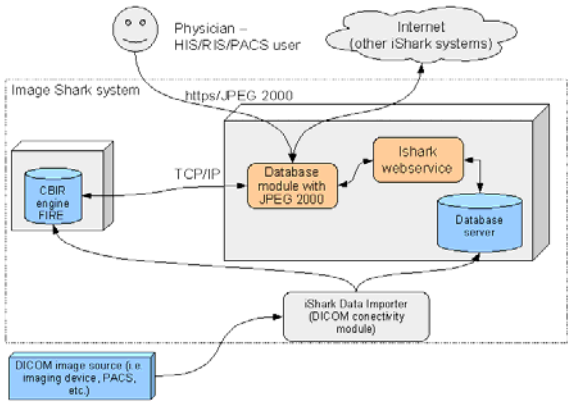


Fig. 1 Schema of Image Shark system

retrieval system, distributed search and JPEG 2000-based image communication with interactive protocols. Such approach gives very flexible and effective image retrieval tool.

II. MATERIALS AND METHODS

The presented ImageShark system consists of 4 main elements

- database environment
- content-based image retrieval system FIRE
- JPEG 2000 interactive codec
- web service for distributed searching

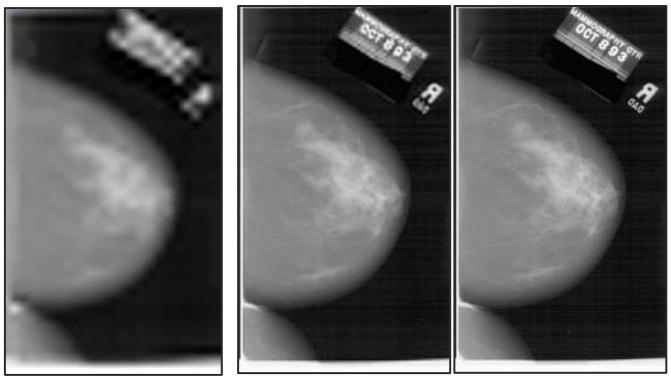
Additionally, there is DICOM data importer, which is able to transfer data between DICOM-compliant devices, like separate imaging systems (e.g. tomographes, mammographs) or integrated PACS.

A schema of information exchange between Image Shark modules is shown on fig. 1.

A. Database environment

The main element is database environment networked to DICOM image source (i.e. PACS or imaging systems). It offers all features expected from such system, with full support for DICOM protocol. It means storing images, connecting viewing stations, printers and other devices to an archive. Storing of data is strictly related to DICOM structures. The data are organized into series/study/patient tree, so, from that point of view, it could be treated as simple PACS.

Fig. 2. Successive reconstruction of progressive image data stream after receiving 0.5%, 2% and 100% of encoded data representation



Generally, Image Shark system is a reference database system, which is a good support for classic PACS environment. If physician wants to find a case similar to the one he has – Image Shark provides a efficient ways to do it.

The user has generally two ways to find an interesting case. The first one – using classic text-based approach. The novel element in Image Shark is that there is possibility to make distributed queries. Every Image Shark database has dedicated webservice, which is registered at central web service.

A second possibility is to search the database for diagnostically similar cases using content-based image retrieval engine.

The sample screenshots from Image shark database environment are available on fig. 5

B. JPEG 2000 communication

Image transmission between database module and the user (diagnostic workstation, tele-radiology) is made by Java ™ applet, which is a front-end to a novel JPEG 2000 codec implementation. JPEG2000 not only allows images to be coded with clearly better visual image quality compared to its predecessor, it also addresses a series of other issues. Unification of lossless and lossy compression modes, robustness to bit-errors to allow image transmission over noisy channels, 5 progression modes (fig. 2) and provision of regions of interest (ROIs) are only some of those that have been incorporated into the new standard. It is therefore not surprising that all these aspects have been rigorously tested and compared to the standard JPEG algorithm some evidence of which can be found in [3].

For efficient JPEG2000 transmission purpose the Simple Image Transmission Protocol (SITP) has been designed. SITP strictly defines the client-server interactions and the way of transmission.

To obtain the maximum performance, it's based on UDP. There are two types of sent datagrams: image data packets and control packets.

The image data packets contain portions of a JPEG 2000 compressed image representation. Each packet is completely self-describing, so that the sequence of packets at the receiver side doesn't matter. The control packets carry client's file requests, datagram's acknowledgements and transmission's parameters. The last one describe priorities of downloading process (progression and ROI parameters), may be specified on the fly, and make flexible way to interact with downloading images.

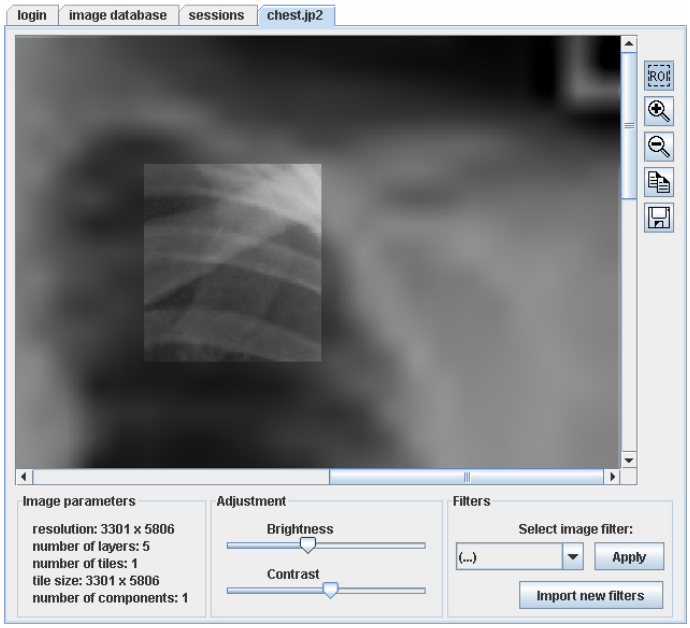
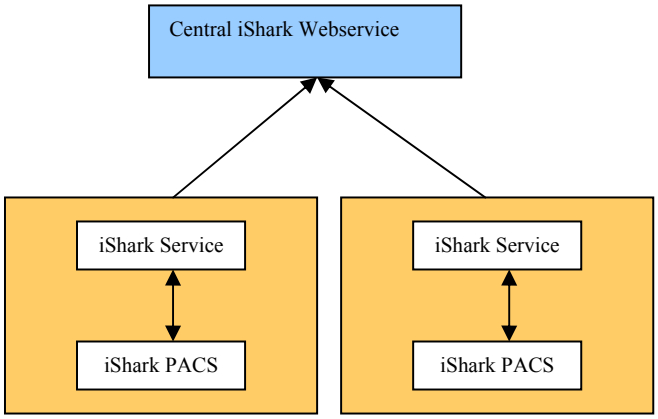


Fig. 3. Interfaces of PIIC; interactive image (JPEG2000 data stream) exchange basing on SITP protocol.

Progressive image data stream decoding significantly



increases effectiveness of large image transmission via low or medium-speed internet connection. It enables image character and content analyze just after few percents of downloaded data bytes. Progressive image data decoding may be even more efficient when used with Region of Interest (ROI) selection. The selected ROI affects on coding blocks sequence in image stream and enables desired area to be reconstructed in the first order.

Implementation of this software in Java language makes it operating system independent. It may run as an stand-alone application as well as an applet in Internet browser. Theoretically, in some scope, it may be migrated to different hardware platform, like Pocket PC or some advanced mobiles.

C. iShark webservice

A standalone Image Shark database module should be "attached" to webservice, which provides search functionality for main module. All search requests from PACS go to the webservice, which makes query to a database. Such architecture give a opportunity to search other Image Sharks, for example located at other medical centers.

When the physician wants to make "distributed" query, PACS module sends it to central webservice, which has a list of all iShark services. The query is then resend to all that services, collected and returned to the client.

Such approach gives a possibility to create distributed image databases, encompassing many autonomic databases,

Fig. 4. Schema of communication between ImageShark applications

so the physician has an access to large number of diversified cases.

D. Content-based image retrieval system

The content-based image retrieval engine, used in our system, is FIRE (Flexible Image Retrieval Engine) [8]

In content-based image retrieval, images are searched by their appearance and not by textual annotations. Thus, images have to be represented by respective features and these features are compared to search for images similar to a given query image.

The ImageShark makes use of some concepts increasing efficiency of retrieval.

1. Query-by-example

Query-by-example means that the system is given a query image and the objective is to discover images from the database which are related to the given query image. Images are represented by features and compared using feature-specific distance measures. These distances are combined in a weighted sum and smaller sum means more similar result image. The most similar images are returned to the client.

2. Relevance feedback

Relevance Feedback is a widely used technique that allows for good user interaction and easy query refinements. After a query has been processed, the user is presented a reasonably large set of results. From these, the user can select some images as relevant results and some images as irrelevant results and requery the system with these sets.

3. Query Expansion

A common method for enhancing the query results is query expansion. In FIRE, query expansion is implemented as an "automatic relevance feedback". The user specifies a number N of images that he expects to be relevant after the first

Fig. 5 Interfaces of ImageShark PACS module

query. Then a query is processed in two steps: first the query is evaluated and the first N images are returned. These N images are automatically used as set of relevant images to requery the database and the K best matches are returned.

Image features

In this paper we only introduce a brief overview of each feature and refer to references for further details. In this work, the goal is not to introduce new features but to give overall look at the features that were used. One should note, that implemented features are at most enough for distinct the modalities and body parts. However, there is a need for more sophisticated and advanced features in case of pathology-oriented indexing. The proposed system is an excellent environment for such development. The work is ongoing.

- Color histograms

Color histograms are extensively used in image retrieval, e.g. [5]. It is one of the most basic approaches and to show performance improvement image retrieval systems are often compared to a system using only color histograms. Color histograms give an estimation of the distribution of the colors in the image. The color space is partitioned and for each partition the pixels within its range are counted, resulting in a representation of the relative frequencies of the occurring colors.

Table. 1 The precision of image retrieval for different body parts

Chest	Skull	Leg - ankle	spine	breast
0,96	0,80	0,85	0,47	0,64

- Tamura texture features

In [6] the authors propose six texture features corresponding to human visual perception: coarseness, contrast, directionality, line-likeness, regularity, and roughness. From experiments testing the significance of these features with respect to human perception, it was concluded that the first three features are very important. Thus in our experiments we use coarseness, contrast, and directionality to create a histogram describing the texture.

- Invariant features

A feature is called invariant with respect to certain transformations, if it does not change when these transformations are applied to the image. The transformations considered here are mainly translation, rotation, and scaling. In this work, invariant feature histograms as presented in [7] are used. These features are based on the idea of constructing features invariant with respect to certain transformations by integration over all considered transformations.

III. RESULTS

The results obtained from our system are related to the two modules: JPEG 2000 codec and CBIR system.

CBIR system

The main parameter to evaluate the CBIR system efficiency was a retrieval precision. The precision is defined as an average decimal f N relevant returned objects among of M all returned objects, averaged over all queries Q

$$p = \frac{1}{|Q|}\sum_{q \in Q}\frac{N(q)}{M(q)}$$

All tests were performed using the IRMA [1] dataset, containing about 9000 mainly radiographic, images. The table 1 presents the results of precision for the images of different body parts. The results are presented in Table 1.

JPEG 2000 communication

High efficiency of progressive and interactive transmission was realized. Significantly increased quality of images in comparison to JPEG2000 (part I) and JPEG coders was noticed. Moreover, accelerated compression process was achieved and different progression modes were verified (interactively ROI-oriented, layers, resolution and precincts-oriented). The brief overview of results from our JPEG 2000 codec is presented on fig. 6 and fig. 7.

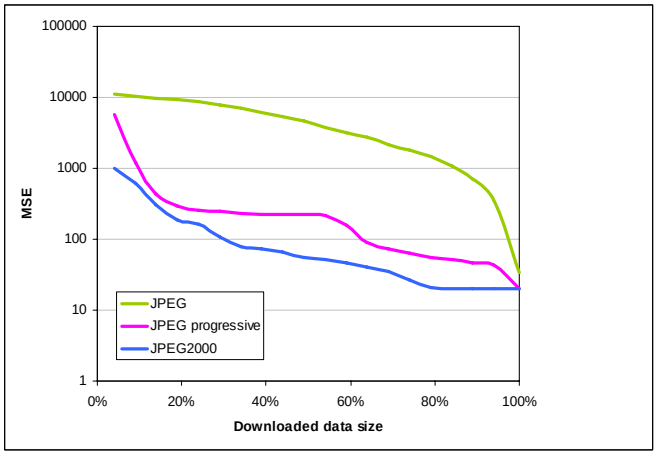


Fig. 6 Typical mean square error distribution for JPEG, progressive JPEG and JPEG2000 rendering

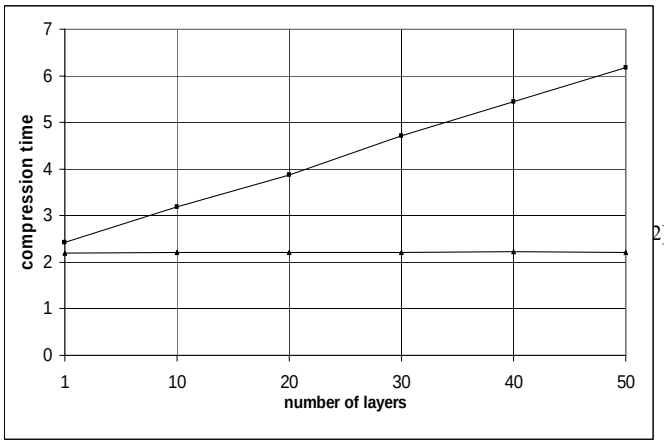


Fig. 7. Reduced compression time by revised PCRD algorithm. Iterative bisection was replaced with block sorting procedure.

IV. DISCUSSION

The presented system consists of several modules, that provide far more efficient way of interaction with image database than classic text-based queries from PACS system. The important thing is that Image Shark does not take out any search functionality known from classic systems. The new features concentrate mainly on distributed search, content-based search and effective, interactive JPEG 2000 image communication.

The distributed searching feature could be very helpful for a user. It gave easy possibility of sharing interesting cases between medical centers, e.g. for better diagnosis or educational proposes. Of course the sent data are anonymized and encrypted.

The content-based image retrieval is relatively new technique, especially in medical domain. The research related to CBIR is still ongoing, not only in our group, so the results presented here are definitely preliminary. The future research will be concentrate on wavelet-domain features for more pathology-oriented retrieval of selected modalities.

However, the benefits from CBIR engine for PACS user seem to be incontrovertible. Even if CBIR is relatively simple and able to distinct only modalities and some body parts – it might be good supplement to classic text query engine, giving an opportunity to verify misclassified DICOM-based information, what happens in clinical practice.

The JPEG 2000 support with our novel codec gives very effective and interactive image communication, what is definitely needed in distributed, spread on huge area environment, like modern hospital.

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Seamlessly and Securely Sharing Health Care Data with Triple Space Communication

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Abstract- The eHealth is an eBusiness scenario in which the integration problems is amplified by the intensive use of knowledge, by the need of accurately handling citizens' privacy and by live or death implications. eHealth has been seeking for semantic interoperability for more then a decade, but securely sharing health data among healthcare organizations remains an open challenge. Many standardization activities (such as HL7 CDA, openEHR, CEN ENV 13606 / EHRcom, DICOM, IHE) are addressing this problem but none of them as achieve the desirable level of flexibility.

In this paper we describe how sharing of health care data respecting parties' autonomy and citizens' privacy is addressed in TripCom, which is a EC funded project starting in April 2006) aiming at developing an highly scalable, semantically enhanced communication infrastructure. Such infrastructure is the result of the integration of Tuple Space, Semantic Web (triple), and Web service technologies. Tuple Space and Web services provides platform for application integration based on persistent publication. Semantic Web provide machine processable semantics in order to allow mechanized integration of services (data and processes). Decoupling communications TripCom will reduce (if not eliminate) the need for a priori knowledge of the partner and communication channel thus enabling multi-party interaction for free.

I. INTRODUCTION

The healthcare organizational structure in all countries is naturally distributed, being a geographical spread of centers at different levels of complexity: from the general hospitals down to individual physicians. The ultimate objective of such a structure is to build a network of complementary centers (hospitals, laboratories, ambulatories, coordination centers, etc.) spread over the territory, to meet effectively the social needs in the area.

This necessary distribution makes it very difficult for clinicians to capture a complete clinical history of a patient, because a patient's health information may be spread out over a number of different institutes or different departments within the same healthcare institute. As a matter of fact, the medical and economic impact of not knowing a patient's complete medical history is profound. Medical practice today still entails sorting through a stack of lab reports, trying to find information on a specific patient. But tens of thousands of people die each year due to lack of information. As reported in many studies, poor information is the "leading killer" in the Western World.

An open challenge in eHealth is (see strategic objective 2.4.11 of 2005-06 Work Programme of IST) to allow health professionals' timely interaction with heterogeneous and distributed medical databases. So, the key problem to address is exchanging patient records among healthcare organizations or among different units within the same organization: radiology, cardiology, neurology, etc.

The main purpose of such a mechanism is to provide healthcare organisations with a complete array of patient information. It should firstly identify a patient and then it should locate the patient's information, including clinical results and labs. The access to and the availability of this information have to be authorised, according to rules determined by the data owner through a data access security policy engine.

II. STATE-OF-THE-ART

A powerful integration technology, which allows for immediate access to distributed information, is needed in order to provide healthcare organisations with a complete array of patient information.

A number of standardization initiative are progressing to address this interoperability problem such as:

- HL7 (Health Level Seven) [1], a non-profit, ANSI accredited Standards Developing Organization, founded in 1987, that provides standards for the exchange, management and integration of data to support patient clinical care and the management, delivery and evaluation of health care services;
- GEHR/openEHR [2], an initiative that foster EHR interoperability started in 1992 as the "Good European

Health Record" EU research project that is currently maintained by the openEHR Foundation;
- CEN/TC 251 [3], the technical committee on Health Informatics of the European Committee for Standardization, that, since 1998, is standardizing CEN EN 13606 / EHRcom [4, 5]; and
- IHE (Integrating the Healthcare Enterprise) [6], a not-for-profit initiative founded in 1998 that does not develop standards as such, but selects and recommends appropriate standards for specific use cases.

Most of those initiatives have been active for more than a decade and, after a first attempt in specifying the format of each of the message that can be exchanged among any pair of systems (e.g., HL7 v2.x [7]), they realized that they need to derive messages and interaction patterns from a common shared conceptual model.

In 1999, CEN/TC 251 was the first to introduce, with CEN ENV 13606 / EHRcom, a list of machine-readable terms to be used for structuring EHR content. The standard defines an EHR information model and a modeling approach for deriving concrete interoperable messages to be exchanged between heterogeneous EHRs. However, the single-level modeling approach, the big number of optionality and the high level of abstraction limited market uptake.

GEHR/openEHR in 2002 moved a step forward proposing the archetype concept [8] and the respective two-level methodology. The first level specifies a health care domain reference model [9, 10] that contains concepts such as role, act, entity, participation, observation, etc., while the second level specifies health care and application specific concepts such as patient, GP, lab result, modelling them as archetypes. Each archetype constrains a set of concepts in the reference model (e.g., "Observation") to a specialize data structure (e.g., "Blood Pressure") and defines the vocabulary, such as SNOMED [11] or LOINC [12], to be used within instances of the archetype. The formal language for expressing archetypes, introduced by the openEHR initiative, is the Archetype Definition Language [13]. A complete example of the "Blood Pressure" Archetype is available in [14].

An alternative approach is offered by HL7 Reference Information Model (RIM) [15] which is the ultimate source from which all HL7 v3 protocol specification standards [7] draw their information related content. The RIM model is an explicit data semantics model by which the messages can be implemented locally and top-down, emphasizing reuse across multiple contexts. Moreover, RIM offers a formalism for vocabulary support that permits to get domain concepts from the best terminologies (SNOMED, LOINC, etc.).

III. CURRENT TREND TOWARDS SEMANTIC INTEROPERABILITY

All the proposals for standardizing an application protocol for the health care sector may differ in the progress achieved, but they are all similar in concept and capabilities. All of them try to address the interoperability problem by introducing a shared conceptual model (i.e., an ontology). This is very similar to the Semantic Web Services approach in which "semantic interoperability" is achieved by modeling, at a conceptual level, Web Services and the domain they are deployed in. In all eHealth standardization efforts, data structure and sequencing information are enhanced with semantic information that encodes the definition of each element of data including its relationship with other elements. Differently from Semantic Web Services, all eHealth standardization efforts are focusing on developing a horizontal ontology to capture the health care information reference model, which can be linked to the most appropriate vertical domain ontology specifying domain vocabularies. In this sence, eHealth standardization efforts lack:

- the possibility of dealing with systems that commit to different horizontal (e.g., one uses HL7's RIM in CDA, the other uses openEHR archetypes based on EN 13606 RIM) and vertical ontology (e.g., one uses SNOMED, the other some proprietary coding), and
- a comprehensive model for automating service usage such as discovery, choreography and mediation, at both data and process level.

So, even if a clear trend toward a harmonization can be perceived and many people expect a unification of the reference information models, nevertheless such result will only be achieved in the long term and many systems, implemented following different version of all these standard protocols, will be on-line even longer. For all these reasons, we believe that eHealth could greatly benefit from the adoption of Semantic Web Service technology [22].

IV. TRIPLE SPACE COMPUTING

Triple Space Computing (TSC) is an innovative paradigm [16] that is taking a significant move towards a new era of the Internet. As reported on the home page of TripCom [17], the leading European project in this area, since the invention of the Internet in the 1960's, the two major evolution step were email and The Web. **Email** changed the communication processes of humans by providing instant communication over any geographical distances in an asynchronous fashion based on the **message-exchange paradigm**. The **Web** changes communication processes of humans by providing instant publication over any geographical distances in an asynchronous fashion. It is based on broadcasting via **persistent publication** of information. So, the two major asynchronous styles of human communication (directed communication via mail and undirected communication via publication) have been significantly improved through email and Web.

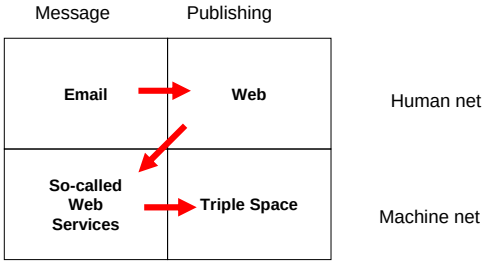

Figure 1. Evolution of communication means for humans and machines as presented in [18]

TSC [18] asserts that the next step for the Internet is likely to be the direct integration of applications and computers via

Web service technology. This network no longer directly interlinks humans but interlinks applications and programs to provide integrated services to the human end-user. However, current Web service technology has only very little to do with the Web. It is based on the message exchange paradigm similar to email communication. Truly Web-enabled Web services will communicate via persistent publication of information (see figure 1).

Realizing this vision and a new technology is the mission of TripCom with the result of the integrating Tuple Space [19], Semantic Web [20] (i.e., the triple based data model of RDF [21]), and Web service technologies (see figure 2).

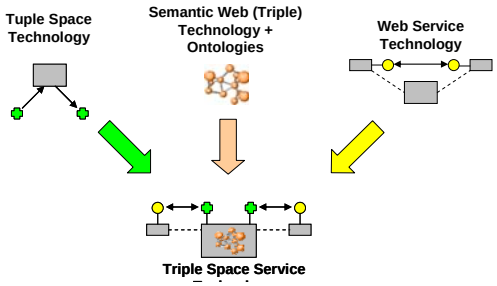

Figure 2. Triple Space Computing results from the integration of three existing and well known technologies.

To this end, on the one hand TripCom plans to improve Tuple Space technology by adding semantics and means to structure and relate tuples in a scalable and linkable Triple Space architecture. On the other hand TripCom plans to improve Web service technologies by adopting the flexible and powerful asynchronous communication model of Tuple Spaces. Furthermore TripCom plan to improve business data exchange standards by use of our new technology and demonstrate the usefulness of this approach in several practical use cases. Finally, TripCom plan to establish a proper security and trust model for the Triple Space to ensure safe communication and data handling, as well as distributed trust models. As the result of the project the combination of these building blocks could give ground to a novel Semantic Web service paradigm.

TSC aims at offering an infrastructure that scales conceptually on an Internet level. Like the Web supports the publishing of Web pages for humans to read, TSC supports publishing of machine-interpretable data. The main advantages in TSC approach, w.r.t. current message-based solution are:

- **time autonomy –** providers of data can publish data at any point in time;
- **location autonomy –** once published the data becomes independent of providers internal storage (thus available even if the providers is not on-line);
- **reference autonomy –** providers are independent of the knowledge about potential readers; and
- **schema autonomy –** the data are can be represented independently for any provider internal data schema.

V. SHARING HEALTH CARE DATA: MESSAGE-BASED VS. TSC-BASED

As we described in section II, the state of the art in sharing health care data is achieved by standard application protocols (e.g., HL7, openEHR, EHRcom and IHE), which define meaningful components of the messages to be exchanged, and domain vocabularies (e.g., SNOMED, LOINC, etc.), which define the meaning of the data transported by each message. On the contrary TSC enables communication via persistent publication of the information

Such message-based communication has proven efficient and effective for certain activities in this area (i.e., hospital administration), but has shown some problems to effectively and seamlessly collecting and integrate data from electronic health records. When addressing such a need, at least two are the possible solutions. One the one hand a possible solution is to build **centralized databases** that would contain all the medical records on every patient. It would also incorporate all of the different access rules and policies regarding different users and different levels of access. But this kind of efforts has **four weak points**:

- the *cost* of building the infrastructure and collecting the data is enormous,
- the centralized repository approach creates *competitive and security issues* about who controls and has access to the information on a specific patient,
- the *difficulty in maintaining up-to-date* a repository originating from a large number of independently evolving systems, and
- last but not least a message once sent (especially in an asynchronous scenario) gives the owner a *sense of disengagement instead of* strengthening the sense of *ownership.*

On the other hand a possible solution is to **exchange messages only when needed**. In this way no central repository is required and the ownership of the data seems respected, but this solution has **several weak points too**:

- each recipient must *know in advance where to look for information*,
- each recipient must *know in advance the terminology* (e.g., SNOMED, LOINC) *to use* when asking for a specific record content,
- each recipient ends up maintaining *a specific interface for each system* it has to interact with, and
- *mining* (for disease prevention, early diagnosis, pharmaceutical research, enhancement of patient safety) *becomes almost impossible* due to the large amount of messages to be exchanged

On the contrary, Triple Space Computing provides an innovative solution to health and medical data sharing among heterogeneous, distributed environment, because TSC is focused on persistent publishing of knowledge (information augmented with semantics) and not on its collection and distribution. Such a new technology will allow authorized users to identify which health care data are available and where they are located in order to share them when necessary (e.g. authorized physicians will have a complete view of the treatments their patients are receiving, and this is very

important for chronic diseases as diabetes). Practical strong points in using TSC are:

- **it is a realistic solution for the data ownership problem** because healthcare organizations will not loose their control over resources and they will be able to share information only with those that are authorized,
- **it provides a simple way to guarantee consistency** because health data won't be neither transmitted or copied but simple used,
- **it supplies a straight forward way to deal with integrity** because data won't be transmitted and it should be impossible for anybody, but the owner, to modify the data,
- finally, **it is a cost-effective solution** because additional storage resources (and related management cost) are drastically reduced.

VI. CONCLUSIONS

Like the Web changed the networking of humans from email exchange to persistent publication, Triple Space Computing aims at revolutionize the networking of machines. The EC is fostering this activity in TripCom a FP6 funded project starting in Aprile 2006.

Within the timeframe of the project TripCom will be put at work for sharing health care data respecting both parties' autonomy and citizens' privacy. We believe that this eHealth scenario is a very demanding test-bed for TripCom because it poses significant challenges in terms of

- **Interoperability**: TripCom should provide a distributed infrastructure that enables maximum decoupling (i.e. time, space, information schema and terminologies) between the various recipients that own the information (e.g. labs, GP's patient file, hospital information systems, etc.) and those recipients that need to elaborate such information (e.g. an application on board ambulance). In other words, TripCom is re quired to support different eHealth services (ranging from general practitioner electronic patient records to hospital information systems, including mobile device like those use by nurses in home caring) in writing information in a way that other eHealth services can later access such information without regards to the standard they implement (HL7, ENV13606, etc.).
- **Information security and tru**st: TripCom should enable the enforcement of Authentication and Authorization rules in a distribute way which is not commonly available and quite worth in highly decentralized scenarios such as healthcare, in which every party involved is responsible for keeping the ownership of the data, but the health of citizens depends on the ability to trustworthy sharing data.

Shortly we expect TripCom will provide a basis for **wide, trustable and confidential access to patient information**.

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Congestive Heart Failure (CHF) and Virtual Hypertension Clinic (VHC)

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Optimal management of patients with congestive heart failure (CHF) has to detect a beginning haemodynamic imbalance in time through daily weight monitoring in order to avoid decompensation and hospital admission.

The " Virtual CHF Clinic " has been designed to serve as an easy to use automatic 'wireless' telemonitoring system used by CHF patients for daily transmission of physiological and clinical parameters to a remote general practitioner or a healthcare provider. By means of a simple, interactive communication between the healthcare professional and the patient, based on client-server interactivity, the CHF disease can be monitored " on –line ", timely and in time.

Using the "Virtual CHF Clinic " enables, by the daily weight reporting, to reduce re-hospitalization and mortality and increases the quality of life of the patients with heart failure.

A "Virtual hypertension clinic " organizes the transfer of primordially weight and blood pressure readings, measured by the patient at home, and the permanent archiving of their trends by means of modern information- and telecommunication technologies. It bridges the spatial distance between the patient and its healthcare professional, allowing therefore the daily on-line observation of the patient's condition and a better possibility to adapt it in time.

By using the "Virtual CHF clinic " , optimizing continuously the therapy and strengthening the relationship between patient and healthcare professional, costly re-admissions can be avoided and the patient's quality of life improved.

Clinical trials and randomized studies show that, although the prevalence of CHF patients economically only accounts for 3 – 5 % , they are considered to be the most expensive ones, because of the frequent hospital rehospitalizations. By using tele-monitoring systems, such as the " Virtual CHF clinic " the cost per patients of the CHF treatment can be reduced by 30 % of the primary care costs . Clinical trials also reveal that the mortality can be brought down by 56%.

Critical success factors however emphasize the importance of easy to use processes so as to maximize the patient's adherence to the therapy, intelligent management of vital signs and symptoms, dedicated specific resources such as trained nurses who's tight relationship with the patient allows for coaching and stimulation of the patient's active participation in self-management his or her disease.

Session 11

International Telemedicine and e-Health Initiatives and Developments

Presented by the International Society for Telemedicine & eHealth (ISfTeH)

P.O.Ca.Ho.N.T.As (Point of Care Home Networked Tele Assistance) an Example of Hospitalization in the Territory

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I. INTRODUCTION

Today in Italy each district of territory requires many interventions planned *home assistance integrated*, making more widespread use of Telematics, particularly those of Telemedicine. The home care assistance is increasing and the operations at home more and more are rising advantages for the Patient and the Continuity Care [1].

II. PURPOSE OF THE STUDY

P.O.C.A.HO.N.T.AS. (Point Of CAre Home Networked Tele ASsistance), is a real service at home of the Patient, particularly terminally ill, through the utilization of telematic technologies: many healthcare services, in short. The main objectives of P.O.C.A.HO.N.T.AS are: to realize a model, a system, a methodology, to guarantee the continuity of care; to show that new communication technologies and distance transfer of clinical data and relevant information can improve the effectiveness of the domiciliary interventions in different contexts. A very diagnostic tele-assistance at home, recording of biomedical parameters and test of laboratory that are transmitted to the hospital center. Partners of the project are: Italian National Institute for the Study and the Care of the Cancer - Milan – Italy; Prisma Imaging Western Europe srl; Coop. La Meridiana srl; University of Milan – Engineering faculty.

III. MATERIAL AND METHODS

P.O.C.A.HO.N.T.AS. is an operating system among the principal subjects: Patient, Physician, Hospital. The project is focused on the use of:

- a "multimedia diagnostic handbag", able to perform image diagnostic and clinical laboratory examination at home of the Patient [2];
- a "Patient network" where telematic technology supports the flow of information that, therefore, precedes the Patient;
- a dedicate web site, Virtual Ambulatory Oncology at Home, for managing Patient information and processes;
- a dedicated Virtual Clinical Folder, in order to store and manage clinical Patient data;
- a Contact Medical Centre for care process management.

The multimedia diagnostic handbag is a system constituted by some diagnostic components, each one able autonomously, to acquire and send over the net the specific data for which it has been developed: ultrasounds imaging (by linear or convex probes), electrocardiogram, blood pressure measurement, spirometry, pulsy-oxymeter, together with the instrumentation for clinical laboratory examinations (Point of Care Systems). These latter tools are based upon the principle of "dry chemistry" requiring minimum quantities of blood, therefore taking in great consideration the state of brittleness of the Patients.

The Patient network is based upon a telematic infrastructure for data transmission and storage that allows the information flow in respect of privacy, security, data integrity, data access selected on the role of the user. This network deals with a difficult problem on the transmission clinical data: certainty of the connection, management of the priorities, inviolability, privacy, accuracy and reliability of the data, contemporary transmission of voice and images, user-friendly interfaces.

The web site that hosts the Virtual Ambulatory for Cancer is based on the principle that a greater efficiency along the flows of data and information that goes from the Patient to the Physician and vice-versa, hands to a greater clinical effectiveness (diagnostic and therapeutic processes) and to a raising of the quality of the life of the Patient and its Family. This Virtual Ambulatory for Cancer will allow the data case management and communication, through the sharing of the information and the images related to the clinical picture of a Patient affected from cancer. The environment of the Virtual Ambulatory is separated in different areas accessible through password from specific and appropriate users. The Technical

Area is for system administration, authentications management and safety. The Information area is devoted to public use, with demonstrations on the services for the citizen and on the results of the activity of the Virtual clinic. Inside the Clinical Area, the clinical data are elaborated and published by the groups belonging to the clinical network; therefore that's a centre for coordination and interchange with the Scientific Community (care profile standardization, analysis of anonymous cases, statistics). Finally, in the Application Area the users can find all the services defined for the monitoring of the clinical framework of the Patient, and the access to such area allowed only the operators involved in the diagnostic, clinical and therapeutic trials of the specific Patient [3].

All the specific clinical information acquired from diagnostic and clinical laboratory examinations of the Patient, will be inserted inside the application sector of the Virtual Ambulatory. Here, together with the information coming from the "clinical history" (registry, examinations of laboratory, hospital admission, out-Patient reports), they will go to constitute the Virtual Clinical Folder of the Patient. The flow of all these information are managed on-line through the telematic net; the domiciliary operator can send over the net the examination outcome data for a real time remote diagnosis by an expert Physician [4]. .

A Contact Medical Centre coordinates the continuity of the assistance, acting as reference point and bridge among the Patient, the clinical structures and the teams of specialized operators using the handbags on the field.

By consultation of clinical information in the Virtual Clinical Folder, expert Physicians can monitor the clinical situation of the Patient, and to immediately appraise therapeutic actions, to forward bookings of visits and to coordinate setting-up of the more suitable and appropriate health structure for admission. The communication between actors and services is one of the keys of the general efficiency of the system; the implementation of the Virtual Clinical Folder guarantees the real time information exchange between domiciliary operator and the Contact Medical Centre. Additional forms are finalized to facilitate the communication between different sectors of the public administration, voluntary and no-profit organizations, families and patients on the territory. This guarantees the safety of the procedures and the mutual level of information need by the actors.

The first goal is to train the two teams of domiciliary operators, taking care of around one hundred of Patients within the city of Milan, over a period of oe year.

IV. CONCLUSIONS

Long term objectives are set along two fundamental directions:

- from one side, to expand the experience and the knowledge developed to other wide impact pathologies with the relevant socio-economic context;
- to consolidate this experience through initiatives finalized to provide the sustainability; therefore, the permanent set-up of the service and the benefits for the Patients and their families well beyond the experimental phase of this project.

If the results will be very positives, it's probabily that P.O.C.A.HO.N.T.AS. will be extended in Lombardy Region and, soon after, in other Regions of Italy.

V. ACKNOWLEDGEMENTS

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Telemedicine Workstation for Developing Countries

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In South Africa there are huge disparities in the availability and delivery of health care services. Health professionals, as well as those in other disciplines, are seeking innovative ways to address the challenge of these inequalities, effectively. Telemedicine, which aims to provide health care across a distance, is an innovative technology, already employed in a number of countries. However, most international telemedicine equipment is totally unsuitable for most healthcare situations in South Africa, associated with the public sector. The shortcomings include lack of robustness, user friendliness, efficient workflow integration and remote maintenance & also inappropriate and insufficient training is available.

The primary health care telemedicine workstation has been developed for specific target market (developing countries whose focus is on primary health care) since most of the focus of telehealth across the globe is in telecare and telemedicine in hospitals. These applications require sophisticated infrastructure and does not always serve those in real need in a developing country. The innovations of this project included no operating system, familiar consumer type interface use, clinical adapted information capturing and differential symptom description system.

The workstation will transfer information communication technology skills to the rural communities and improve South Africa's global competitiveness. The Workstation will be suitable for deployment in a Telemedicine network in the rest of Africa and other developing countries and serve as a viable tool for rural Primary Healthcare, education, social and economic development. In additon it will be an affordable Telemedicine workstation and sustainable Telemedicine networks across Africa

Keywords: Primary Health Care, Developing Countries, Telemedicine, Innovation

Healthcare Systems Transformation – The Role of Ehealth

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Healthcare Systems around the world are increasingly under pressure as a result of the growing burden of chronic disease, the scale of which has been unmasked by the changing demographics in both developed and developing countries alike.

The role of eHealth is now being seen more as an enabler for healthsystem transformation as healthcare providers and governments recognise that they have to meet the healthcare demands of the future citizens. The role of IT and the development of integrated Clinical Information Systems are both fundamental to this transformational process.

At the same time technology is advancing apace and the concept of The Biological Continuum allowing an understanding through body systems to viscera to cells and molecules down to genes will be discussed and considered.

Examples of healthcare system transformational change both on small and also on national scale will be described and some predictions made as to the likely direction as healthcare provision evolves over the next 30 years.

The Creation of a National Telemedicine/E-Health Association in Nigeria and Its Impact on the Federal Ministry of Health ICT- Committee

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The national telemedicine/e-health association in Nigeria called the Society for Telemedicine and e-Health in Nigeria (SFTeHIN), created April 2005. The association is an organization formed to keep with global trend in healthcare delivery the use of telemedicine and e-health as a tool to improve healthcare delivery system in Nigeria. Society for Telemedicine and e-Health in Nigeria serve to promote the cause of telemedicine/e-health in the public and private institution in Nigeria. The society educates government about telemedicine/e-health as an essential component to the delivery of modern healthcare. The Federal Ministry of Health (FMOH) inaugurated its ICT-committee in 2003 charged with the responsibility to deploy ICT facilities for the ministry in other to make information about its activities available and accessible to its workers, other arms of government; its development partners; private sector organizations, the Nigerian public and the world at large. Activities of the society since its creation, which included organizing national stakeholders meeting on developing national telemedicine/e-health program, first telemedicine/e-health workshop in Nigeria has led to good working relationship with the government agencies and nominated her as a member of the FMOH's ICT-committee. The committee is committed to working with the society and its partners on how to deploy ICT in the ministry, which include; electronic linkage between FMOH and its hospitals; FMOH e-learning center/ e-library; facilities for telemedicine and human resource development implications of these projects. The national awareness raised by the society on issues of developing e-health in Nigeria contributed to the decision of the committee, resolved to implement some of this project in the next fiscal year (2006). To complete the computerization of FMOH's administrative and programmatic functions; carry out a country feasibility study of telemedicine in Nigeria with the society in view to facilitate its development in the country. One of the components of the Health Sector Performance issues addressed by the Health Sector Reform Program is improving the stewardship role of government by deploying information and communications technologies (ICTs)

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I. INTRODUCTION

As the healthcare market continues to evolve, technology will play an increasingly important role in an integrated delivery system's ability to provide high-quality, cost-effective care. Healthcare leaders must be proactive and forward thinking about their technology investments. The financial investment Successful projects establish proof of concept to demonstrate the validity of remote delivery systems. Health services and education are both critical issues in rural economic development, and both can be delivered over an infrastructure which has been developed to deliver either one for technology innovation can be significant. Telehealth is the use of electronic information, imaging and communication technologies to provide and support health care when distance separates the participants:

- The planned health systems and services would be such that offer quality health care services and provide protection from risk for the poor against the catastrophic economic effects of illness.
- Reforms would not only enhance the financial and cultural access of the people to health care, particularly the poor, but also their physical access which, in a majority of Nigerian communities, remains a substantial challenge.

II. SFTEHIN

At the last ordinary General Assembly of ISFTeH held at Luxexpo, Luxembourg April 6, 2005 Nigeria was proudly represented by Dr. Joseph Awolola. The congress generally agreed that individual members should get ehealth associations started in their respective countries to help facilitate development, dissemination of knowledge in telemedicine and ehealth worldwide.

Society for Telemedicine and ehealth in Nigeria (SFTeHIN) was established April 2005 and presided over by Dr. Joseph Awolola becoming a national representative member of ISfTeH July 2005 with the vision of introducing Telemedicine and creating an e-Health network in Nigeria for the aim of providing the nation as whole with a rapid, reliable and cost effective way of healthcare delivery services;

medical education including research, development, practical application and supplementary training to promote national health telematics particularly telemedicine and e-Health.

The Society (SFTeHIN) is a non-governmental and not-for-profit society; a national representative member International Society for Telemedicine and e-Health (ISfTeH).

The Society is in collaboration with the WHO collaborating centre on Telemedicine, Norwegian Telemedicine centre, Norway, National Information Technology Development Agency (NITDA) and National eGovernment Strategies (NeGSt) on developing telemedicine in Nigeria in 2005 and will be involved in many more in 2006. .

As a way of fulfilling part of its objectives, SFTeHIN took the initiative of organizing a multi-national stakeholders meeting on "Developing Sustainable Telemedicine and e-Health Programme for Nigeria" invoking the public private partnership. The key points of the meeting were the need To support the Federal Government of Nigeria policy for Information Technology (IT), to invest in IT-based health care systems to ensure that Nigerians have access to good health care delivery and strong emphasis on the need for high level collaboration among stakeholders as the most critical success factor in any telemedicine and e-health initiative.

This meeting was soon followed by the premiere telemedicine/eHealth workshop in Abuja in October 2005 organized by NEGSt under the auspices of NITDA with SFTEHIN actively involved in organization and facilitating the program. Key amongst the guests at this event were the Minister of health who said "Government recognizes the need to support and promote telemedicine and eHealth to the limit that competing interests for funds will permit. Furthermore, in keeping with global trends in health education, telemedicine and eHealth will be included in the curriculum of medical education in Nigeria for capacity building. Also what I will call the National Telehealth Project will be synchronized with international efforts and standards", he was later capped as the National ehealth Champion. Also present were the various stake holders including Medical directors of the Tertiary institutions, captains of industry, IT chieftains amongst others, and the video conference availed the participants an opportunity to interact with the best minds in the field such as Dr Shetty, Tove Sorensen and Dr Alexander Leis. Overall it was a huge feather in the Society's cap as the vision was making headway.

The Federal Ministry of Health (FMOH) created its ICT committee in 2003 charged with ICT related duties. Based on the track record of the society it was nominated to function on the committee with a view to helping the FMOH achieve its ICT related reform goals.

On the backdrop of the Nigerian health sector being rated 187th in the World, there arose the need to put the sector in order and Seven (7) strategic areas of work have been identified, through a nation-wide consultative process that started during the first term of President Obasanjo's administration. It is within these areas that the Ministry intends to undertake various reform initiatives. The areas of work are:

- Improving the stewardship role of Government;
- Strengthening the national health system and its management;
- Reducing the burden of disease;
- Improving availability of health resources and their management;
- Improving access to quality health services;
- Improving consumers' awareness and community involvement; and,
- Promoting effective partnership, collaboration and coordination.

The stewardship role of government is the key that holds the other parts together with the planned deployment of ICT as one of its strong points. This is because the next 5 areas are directed towards developing a functional primary health care system that can be more effectively managed, monitored and developed with the proper implementation of telemedicine/eHealth in a mainly rural economy where poverty and distance play a major role in limiting the people's access to qualitative and quantitative health care. The last area of multi-sectoral involvement and cooperation also requires diligence and dedication to the cause by the Government, as political will is paramount for collaboration. The crosscutting areas of work that will also receive focused attention include an effective health management information system (monitoring & evaluation) and a communication strategy for mobilizing and sustaining the reforms.

With this foundation, the ICT committee with the Society's inspiration is actively working with other stakeholders on achieving the following goals this year

1. Electronic linkage of the FMOH with its hospitals with the aim of creating something similar to a Wide Local Area Network (WLAN) whereby the tertiary hospitals all can access each other, exchange information and create a reliable central database. NeGST is saddled with the responsibility of developing a program that would be the template for the database and work is actually at the advanced stages
2. Creation of an e-Library /e-Learning center for the purpose of increasing the level of information dissemination concerning common health problems, activities of the ministry and it's programs and to train medical and paramedical personnel.
3. The execution of a nationwide feasibility study with a view to providing recommendations to the major stakeholders in tandem with the government on the discovered needs and focused plan of action. This project will benefit from the planned national census and may take off with a state serving as the template.
4. Capacity building exercises and acquisition of facilities to enable to achievement of aforementioned goals.

However facing this lofty goals are some daunting challenges that actually are the bane of health care delivery within Nigeria

- The poor definition of the roles and responsibilities of key actors. Government has a responsibility, through various statutory instrumentalities and in a coordinated

manner, to ensure that all key stakeholders (Federal, State and Local Governments and the wider civil society organizations and development partners) know and play their roles and assume their responsibilities for the management of the health system for overall health development, as well as accept responsibility for the role of the health system in the overall poverty alleviation and macro-economic development of Nigeria;

- The need to strengthen our various Ministries of Health's role and responsibility in their stewardship in health by providing the requisite enabling management and stewardship tools, such as relevant policies, operational health sector strategic development framework, legislation, financing, human and physical resources, etc;
- The challenges of fostering inter-sectoral collaboration with other arms of government and the wider society to ensure that all aspects of our stewardship roles and responsibilities are effectively carried out;
- Poor dissemination and enforcement of health policy implementation;
- Absence of legal and constitutional backing for some major policy thrusts, including the misleading assumption that health is on the concurrent list in the Constitution;
- The fact that current policies are not inclusive of the definitive roles and responsibilities of the private sector;
- The generally depressed state of evidence-based budget and plan management practices; and
- Inadequate funding of the health sector.

These problems however can be surmounted if the following can be ensured

- National health institutions re-profiled with well-defined roles and responsibilities.
- Structural reform of the Federal Ministry of Health to make its bureaucracy more efficient and effective.
- National Hospital Agency established to enhance effective coordination in terms of policies, standards and performance of tertiary/specialized hospitals.
- Devolution of ownership and/or management of tertiary health institutions.
- Establishment of a National Blood Transfusion System, which shall be located at the national level, each of the six geo-political zones, and the military.
- A revitalized /functioning PHC system.
- Teaching Hospitals regaining their status as centres of excellence for the provision of quality tertiary care, training of high quality doctors/nurses, etc., and the conduct of relevant medical/health research
- National Health Management and Information System (NHMIS) developed.
- Construction and institutionalization of a National Health Account (NHA).
- Development and implementation of a comprehensive health care financing strategy.
- Development of a performance-based human resources management system
- Leaders supporting and promoting the HSR process, through practical activities and involvement.
- Communities participating in the design, implementation, monitoring and evaluation of health care delivery as it affect them.
- Communities and consumers being well informed about their rights to quality health care.
- Communities become co-owners and co-financiers of health care delivery.
- Health consumer protection groups formed and actively engaged on health issues.
- Consumers and communities imbibe practical actions
- The need to create a national committee that would consist of representatives of the federal Ministries of Health, Science and Technology and Communications

•After discussing the issues on the implementation of telemedicine/e health in Nigeria, the next steps to be taken will be that:

•The National committee should consider the following points:

- Proposal of a framework for rational development and deployment of national or organizational capacity for telemedicine systems in Nigeria.
- Establish core principles to ensure coordinated, cost effective and integrated approach to telemedicine in Nigeria.
- Consider ways to assess effectiveness, efficiency, and whether or not telemedicine is improving equality in the access to health services for all Nigerian citizens.
- Recommend a long-term process for addressing issues as they emerge with changing technologies and patterns of health care practice in Nigeria

III. CONCLUSION

Since it's inception in April 2005,the Society for Telemedicine and eHealth in Nigeria has moved in leaps and bounds with the two groundbreaking meetings it organized last year- September and October. Its incorporation into the ICT committee for the Federal Ministry of Health is in recognition of the importance of Telemedicine and eHealth to the development and improvement of existing healthcare delivery systems in Nigeria and the immense International support from the parent body is a good omen of things to come. This however is not the time to rest on its oars but rather to consolidate on its gains and build a lasting framework for telemedicine and eHealth in Nigeria and Africa as whole.

CONCLUSION

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Virtual Health Care Knowledge Center in Georgia

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The paper describes the one year results and the organizational impact of the "Virtual Health Care Knowledge Center in Georgia" project: an on-line integrated web-based platform to provide remote medical consultations and eLerning cycles. The project is the NATO Networking Infrastructure Grant to promote the development of telemedicine in non-NATO countries. The project implemented a pilot to organize the creation of national eHealth network in Georgia and to promote the use of innovative telemedicine and eLearning services in the Georgian healthcare system.

I. INTRODUCTION

Several years ago, any talk related to the Internet, would have to be preceded by an explanation of what it is and how it works, but at present Information and Communication Technologies (ICT) became the essential part of life and practical activity. Telemedicine is the dissemination of medical information using the digital medium. This field absolutely depends upon ICT [1]. The communication technologies have two tasks in telemedicine. Firstly, they may serve as a repository of knowledge from which healthcare professional interested in telemedicine techniques may draw. In the field of telemedicine, this aspect still has a long way to go. More importantly though that, it may be the conduit of which telemedicine is implemented. For the most areas, the communication technologies represent the easiest existing infrastructure to use, with the World Wide Web (WWW) being best suited to multimedia applications [2].

Telemedicine has a great potentiality; however there are unfortunately today few examples of large services. The benefits of expanding its use are threefold: it can improve the quality of healthcare services; it allows a better exploitation of limited hospital resources and of expensive medical equipment; and it helps to address the problem of unequal access to healthcare. Throughout the world the number of people requiring special care is increasing as the proportion of elderly people rises, at the same time, in a high-tech age the expectations of the society for a better healthcare are also rising. Telemedicine offers the opportunity for improving healthcare service and for making healthcare expertise available to underserved locations [3].

Telemedicine is innovation for Georgia. This field is the ideal combination of medicine and ICT.

The "Virtual Health Care Knowledge Center in Georgia" project is implementing pilot actions both in telemedicine and eLearning. The project is part of NATO Networking Infrastructure Programme. The project participants are Charite Clinic (Germany), Georgian Telemedicine Union (Georgia) and Kutaisi Regional Center of Public Health Department of Ministry of Labor, Health and Social Issues (Georgia).

The main goal of the project "Virtual Health Care Knowledge Center in Georgia" is to prove flexibility, cost effectiveness and organizational impact of telemedicine services for healthcare organizations by developing a community service useful and profitable in the following fields: remote medical consultations, eLearning, clinical data management, cooperative clinical information management broadcast of multimedia contents between project participants for teleconsultation and training purposes.

Introduction of telemedicine is important for Georgia, because this field is considered as an economical means of development of healthcare sector in countries with middle- and low-income and of achieving national policy objectives with regards to the improvement and the extension of healthcare. There are five main areas where telemedicine is playing an increasing role in healthcare sector development:

a) Connection of healthcare professionals from different regions to each other and foreign colleagues via Internet
b) Allocation of sophisticated diagnostic and therapeutic methods
c) In quality improvement
d) In education and training
e) In the improvement of efficiency of healthcare services.

II. DESCRIPTION OF THE PROJECT

The probability of an incorrect handling of a relevant medical data is still dangerously high, mainly due to:

a) Environmental factors – many medical organizations are not fully able to face every disease, e.g., in a

peripheral hospital only the most frequent pathologies for that geographical area are treated

b) Instinctive factors – the decision making of a physician is usually mainly based on the limited number of cases in her/his experience and/or on a static medical knowledge available from databases of main published studies. This factor is very variable between different specialists and general practitioners
c) Emotional factors – medical decisions are often influenced by he opinions and the decisions that have been taken by the physicians that already have examined the same patient.

As a consequence the probability of an serious error occurrence could be high and the probability of its recognition and correction very low. This frequently causes a repetition of exams in the same time or in different medical units and it slows down the diagnostic process (resources waste) and the proper treatment. So, proper actions for improving the working procedures have to be taken [4].

Correct medical information management and transmission is a key point, hence the introduction of innovative ICT can be relevant. Furthermore, ICT performance, and in particular the telemedicine bandwidth requirements are high and rather asymmetric (there are more often needs for retrieval than for entry or update a medical data). Multimedia clinical record transmission is a suitable topic for the telemedical networks. Each actor connected to a network need to be driven towards the most proper resource available on it, e.g., an important objective of clinical data management is the availability of common and precise data about patients treated in medical centers connected to the network [5, 6].

The "Virtual Health Care Knowledge Center in Georgia" project also will provide a new teaching/learning service based on collaborative and bi- and multi-directional communication processes. Interest in co-operation does not affect only teaching but all intellectual and cognitive activities, "collaborative learning" will refer to a method in which actors work together towards a common task. Physicians are traditionally responsible for their own and their fellow's learning: in this way, individual success helps all others to achieve positive results. In fact an active exchange of ideas in between small groups does not only improve the interest in communicating but also promotes a development of a more critical thinking.

The project's main telemedicine applications concern: remote second opinion consultations and teleconferencing (one to one and/or multipoint). On the other side the main applications that have been implemented for eLearning are: video lessons (live and/or on-demand), a media library, and a laboratory collaborative learning environment. Since the request for more effective healthcare services is increasing over the years, the health delivery system needs to focus on:

1) Improving the performance of the healthcare services
2) Optimizing the running costs of the healthcare structures and the allocation of resources.

For this reason, health is now following a "delocalization" process: information, i.e. knowledge and skills, should be moved, rather than people or tools. The "Virtual Health Care Knowledge Center in Georgia" project wishes to provide answer to such an evolution to eHealth. In particular, it will offer healthcare organizations the chance to extend their information services to a larger medical community.

III. OBJECTIVES AND ADVANTAGES

Reference data and medical support services provided by the "Virtual Health Care Knowledge Center in Georgia" project are complying in a cost-effective way to the continuously increasing healthcare professionals' needs for a faster access via Internet to data and services supporting decision making in clinical practice and medical education. In particular, the services provided by the "Virtual Health Care Knowledge Center in Georgia" project are:

- Access to clinical and educational data, tutoring and eLearning functions: reference data (clinical data) and text databases for diagnostic and patient care decision support and for undergraduate or postgraduate courses ad professional continuing education schemes support; educational tutoring and learning progress assessment; off-line and on-line consulting on specific issues;
- Support to the teleconsulting sessions with the above mentioned data and workgroup functions as forum. Most patient data are stored in large files. For this reason, the transfer rate of the multimedia contents in the web-sites is a qualifying element to satisfy the needs of healthcare professionals, scientists and students in the various medical areas.

It should be noted especially, that a medical record collects data items from direct patient examination and from medical instruments. These "events" representing significant episodes in the patient's medical history, belong to two classes: analytical events and descriptive events. This core functionality of the project's system had been implemented by Charite Clinic.

The healthcare staff worldwide needs to certificate their participation in continuing medical education (CME) programs. These courses have traditionally been done in the past either face-to-face or via reading materials. Web-based technologies allow courses be available on-line, this enables healthcare operators to train themselves at any time and from any location and available information to be greatly increased. Traditional web systems are too simple to be really effective and the commercial eLearning platforms require a complex configuration and are too "technical" for costumers, furthermore, the focus of this system is often on on-line interactivity, while a structured arrangement of educational contents must be the first priority [7, 8, 9, 10]. For this reason a new system will have been developed having the following features:

- Structured courses – stored in a relational database maintained by a suitable administration tool. Each course is multi-

language and is integrated with evaluation forms. The course structure (lessons, concepts) is easily editable and the results are immediately available.

- Innovation in content – the system is based on an object called "concept", an innovative way to build a lesson. This concept encloses images, videos and texts that are needed to communicate educational concepts.
- On-line interactivity – learners communicate with teachers by using audio/video/whiteboard interaction in multi-user sessions (virtual classrooms). The quality of audio/video depends on the network but the system allows the exploitation of asymmetrical ADSL.
- Minimum configuration of users – the system will run on most hardware and operating systems and it needs no configuration of the user workstation. Also the server runs open software products to reduce costs and to increase portability and performances.

The main "Virtual Health Care Knowledge Center in Georgia" project's objective is the availability of a common base of medical data relevant to any Institution connected to the web. Telecommunication network and proper software provide patient data in remote sites enhancing the co-operation between healthcare professionals belonging to different Institutions. The system guarantees:

- Patient assistance – the underlying idea is that the information collected during the contacts with healthcare organizations has a great importance for the further treatment of patient diseases. Data have to be accessible by authorized medical personnel only. The patient must not be found as far as possible, to working and traveling constraints. So the patient could have contacts with other Institutes, possibly abroad, and her/his data must be easily accessible, provided the security permissions are verified. Medical and paramedical personnel sore and retrieve relevant data coming from exams, anamnesis, therapy and any other event that is relevant to patient contacts with any Institute joining the system.
- Decision support based on large statistical samples – The availability of a wide collection of medical cases can be very useful in determining the best decision about a new patient.
- Research activities – the dissemination of large number of medical data integrated in a single network implies that a huge amount of data will be available. This information can be used as a common base for scientific statistical analysis for medicine.
- Economic objectives – the system gives relevant economical advantages. It allows patients be treated in remote sites, sharing with physicians in Centers of Excellence the relevant data for medical decisions support and diagnosis. Medical protocols and guidelines for disease treatment can be shared. Medical personnel in remote sites can join Centers of Excellence programs and associations. It enhances the autonomy of the remote sites hospital system, increasing efficiency and allowing quality assessment.

IV. Decision Support Functions and Organizational Impact

The "Virtual Health Care Knowledge Center in Georgia" project's patient-record is based on "events", i.e., episodes that occur during the patient's contacts with the healthcare organization. The patient's record is the collection of all his/her events; these medical data could be heterogeneous, ranging from numerical values to radiographical images. A relevant step forward is that information is gathered during routine patient treatment, not during activities explicitly dedicated to scientific research within Universities or research Institutes. Educational module slides will be already collected in a central database. The particular importance of this point is:

- Data flow is asymmetric
- There is no requirement for the session leader workshop. The roles of the participants is logically assigned by the software and not dependent on the terminal features
- Slides are collected in a hierarchial form in a relational database. In this way structured access to courses are granted and large amounts of content are administered and maintained centrally in well ordered way
- Access to contents is granted conditionally based on user privileges. The tutor grants access to the appropriate educational material. The system allows also dynamic on-line transmission of local images and even clipboard graphic paste of graphics in the virtual board. Of course the asymmetric nature of the network is not efficient in this case. The program allows user commands to be automatically sent to all participants that see the same window and can give commands that will be broadcasted to the others.

For the users there have been saving from:

- A operating cost reduction through the optimization of resources
- A reduction in costs of training for the physicians through eLearning and access to medical database

- A decrease in travel costs and time for physicians visiting other hospitals for consulting.

V. RESULTS AND FUTURE PERSPECTIVES

Perspectives and strategies for telemedicine are currently evolving, as emerging operative requirements would allow self-sustainable large scale exploitation while recent technological developments are available to support integrated and cost-effective solutions to such requirements. However, as far as we know few telemedicine services have proceeded to large scale exploitation, even after successful technological demonstration phases. Main exploitation drawbacks, problems and deficiencies have been:

VI. Partial solutions approach instead of integrated total approach to healthcare assistance needs
VII. Lack of economical drive and consequently no self-sustainability for large scale exploitation
VIII. Insufficient H24 (24 hours/day 365 days/year) medical and social operators support
IX. Insufficient networking approach for medical operators and scientific/clinical structures.

During the first year of the implementation of the "Virtual Health Care Knowledge Center in Georgia" project the teleconsultation server was created by Charite Clinic. There are implemented eGroupWare, Moodle and Teleconsulting tools at server.

eGroupWare is a type of software that allows a group of individuals on a network to work on the same project at the same time. This programme allows users to share documents, calendar and address, plan projects or manage news. The main aspect for choosing it is the large community and the fact that "Virtual Health Care Knowledge Center in Georgia" is the "young" telemedicine project that is assuring a promising future. eGroupWare is arisen as a subsidiary to phpGroupWare, but with some known bugs fixed and a redacted desktop.

Within the scope of telemedicine, teleconsulting is an important sub area, where several cases can be discussed with experts all over the world. The main idea for Teleconsulting tool was the possibility to create a case by an external Team: the essential data are stored on the server and they are viewable by all interested groups. The last one can comment and recommend the questions and requests. After finalization the case is stored on the server and can be viewed by the users. Simple Machines Forum (SMF) is used for organization of teleconsulting. The SMF is the only one that contains the possibility to attach files to a thread.

A learning management system (LMS) is a software application of Web-based technology used to plan, implement, and access a specific learning process. Typically, a learning management system provides an instructor with a method to create and deliver content, monitor student participation, and access student performance. A learning management system may also provide students with the ability to se interactive features such as threaded discussions, video conferencing and discussion forums. Moodle is a software package for the production of Internet-based courses and web-sites. It is provided freely as Open Source software (under the GNU Public License). The word Moodle was originally an acronym for Modular Object-Oriented Dynamic Learning Environment, which is mostly useful to programmers and education theorists. It's also a verb describing the process of lazily meandering through something. As such it applies both to the way Moodle has been developed and to the way a student or teacher might approach studying or teaching an online course. Moodle will run on any computer that can run PHP and can support many types of database [2].

The first year of implementation of "Virtual Health care Knowledge Center in Georgia" project was focused upon the setup and installation of the server, creation of experts group and realization of remote medical consultations in static mode. The online consultations and eLearning courses are the topics of the second year.

After the first year of the project's implementation it was revealed, that telemedicine is the most important for the ensuring the safe primary medical care in Georgia. The first contact of patients needing medical help is the contact with the local primary care health center. Second opinions from specialists are often required in primary care health centers (i.e.: radiology, cardiology, dermatology, consultations with specialists regarding further treatment of the patient; is hospitalization needed or not? etc). An efficient and appropriate strategy of medical care can be worked out at the initial steps of patient's contact with healthcare. Such an approach can avoid unnecessary hospitalization, and will be a substantial contribution to the reduction of health costs.

Telemedicine has the potential for offering the country as qualitative so quantitative improvements. By comparison with the usual health services telemedicine introduces added value and a positive impact at social, economic and cultural levels. Therefore, telemedicine is beginning to have an important impact on many aspects of healthcare in non-NATO countries. When implemented well telemedicine may allow these countries leapfrog over their developed neighbors in successful healthcare delivery.

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Tele-Virtual Reality and Tele-3d-Computer Assisted Surgery in Croatia: The Newest Telemedicine Technologies of the 21st Century

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Objectives: During 3D-CAS as well as Tele-3D-CAS (computer assisted surgery), the computer with its operative field image allows the surgeon, by means of up-to-date technologies, to connect the operative instrumentarium to spatial digitalizers connected to the computer. Upon the completion of the tele-operation, the surgeon compares the preoperative and postoperative images and models of the operative field, and studies video records of the procedure itself (www.mef.hr/3D-CFESS).

Methods: The surgeon and consultants use software for CT image previews and 3D-model manipulations on top of collaboration tools to define the pathology, to produce an optimal path to the pathology and to decide how to perform the real surgery. Using tele-fly-through or tele-VE through 3D-models, both surgeons can preview all the characteristics of the region, and so predict and determine the next steps of the operation (www.mef.hr/warwounds)

Results: We used several standards to encode live video signals in telesurgery, such as M-JPEG, MPEG1, MPEG2 and MPEG4. It has been definitely concluded that MPEG4 streams, without audio, have the best picture quality for the operating field/endo camera. For conferencing/consultation cameras used between two or more connected sites during the surgery, we used JPEG and MPEG1 stream with audio. ORs were connected using several computer network technologies with different bandwidths, from T1, E1 and multiple E1 to ATM-OC3 (from 1Mb/s to 155Mb/s). For computer communications using X-protocol for image/3D-models manipulations, we needed an additional 4Mb/s of bandwidth, instead of the 1Mb/s when we used our own communication tools for the transfer of surgical instrument movements. The final step of this project is to create an extremely large uncompressed database (2x47 TB), where all multimedia content will be saved into a massive database with a maximum resolution, and in a format not depending on a resolution. In a case when this is impossible, e.g. with video content (movies), then the compression is as small as possible so that the content is able to maintain the highest quality accessible. For instance, audio data are saved on media for data in a linear format, without any loss in quality (www.mef.hr/orbit).

Conclusions: Using intraoperative records, animated images of the real tele-procedure performed can be designed. Beside otorhinolaryngology, this has also been used in other fields. The more so, in addition to educational applications, VS offers the possibility of preoperative planning in sinus surgery, and has become a very important segment in surgical training and planning of each individual surgical or telesurgical intervention, not only in the reigon of paranasal sinuses. Our tele-3Dsurgery allows surgeons not only to see and to transfer video signals, but also to transfer 3D computer models and surgical instrument movements with image/3D-model manipulations, in real time during the surgery.

www.mef.hr/MODERNRHINOLOGY

Internet Based Tele-rehabilitation Videoconferencing

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I. INTRODUCTION

Rehabilitation therapies teach people with musculoskeletal disorders how to compensate or regain function. There are some difficulties to establish telerehabilitation therapy as access to IT device, computer skills, etc.

During winter, particularly strong and cold, many patients disappeared from out patient rehabilitation centers. Physiotherapist appearing on the computer screen or mobile device display seems to be a very attractive opportunity for many patients.

Certainly, some of rehabilitation sessions require direct physiotherapist presence but in other session dominates supervising role of the physiotherapist. The remote sessions may run utilizing teleconsultation network. Therapies are provided over a relatively long period of time to improve the patient's endurance and strength.

Telerehabilitation holds great promise also for institutionalized patients who have provided these therapies at a setting which is under medical (nurses, nursing assistants) control (a nearby ambulatory clinic, the nursing home, etc.).

II. MATERIAL AND METHOD

Two different research approaches were undertaken during the study. The one was to review consecutive patients in out patient orthopedic clinic about their attitude to telerehabilitation. The second was to test the quality of available technologies in use for telerehabilitation sessions. Recently, a new software paradigm has been developed for providing telerehabilitation sessions. A selected group of patients was instructed how to use the application. All those patients were familiar with personal computer use and how to browse an internet. The Macromedia Flash Player was set on both sides of videoconferencing system. The Real Time Messaging Protocol was implemented for multimedia communication. Currently, two way system of communication allows the patient to follow the therapist instructions and direct inspection of exercises by the therapist utilizing web cameras. We have tested usefulness of desktops, laptops and WLAN connected personal digital assistants and Flash Player operating mobile phones to create patients terminal.

III. RESULTS

Two hundred patients (117 females, 83 males) were asked about their preparedness for telerehabilitation. Their average age was 53 years (15-83). Only 30 declared e-mail address. More than half of the group declared an easy access to PC (54, 5%), but only 3 have had web camera. The popularity of mobile phones could be noted recently. Seventy six and half percent of our patients were mobile phone users. Almost 40% of patients were determined to use internet based telerehabilitation.

All of those attempts to telerehabilitation (desktops, laptops and WLAN connected personal digital assistants and Flash Player operating mobile phones) were evaluated positively by both kinds of users. However, they confirmed some obstacles and inconveniencies previously premised.

IV. CONCLUSION

We conclude that use of telerehabilitation via internet may significantly improve the process of function regaining with additional possibilities for joining leading physician during such sessions. Remotely controlled rehabilitation may also overcome patient's absence in outpatient offices during bad weather conditions and also to reach the most distant patients.

Key words: Telerehabilitation, Macromedia Flash Player, videoconferencing

Telemedicine Developments: A Regional Consorted Action in the Interreg Iiic Programme

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Abstract- The overall objective of the INTERREG IIIC Telemedicine project is to explore the effects and opportunities for local planning of health and medical services and housing facilities in urban areas via the stimulation of more efficient and innovative information technology (IT) based solutions for domestic health and medical care. The most important task of this INTERREG IIIC Telemedicine Project is to establish a seamless and secure exchange of patient data between authorised health care providers and patients using technical communication standards. Additionally, there will be an international platform for exchanging knowledge. The use of IT in health care is steadily increasing and applications which support the exchange of patient data across the continuum of care are becoming more available. This article describes the setup of the project and current state.

V. INTRODUCTION

In the beginning of 2005, the preparations for an international project under the INTERREG IIIC programme started. The initiative for this international collaboration was undertaken by the city of Eindhoven (Municipal Public Health Services) and joined by six regions[1] are participating: Southampton (UK), the Hague (NL), Bologna and Genoa (I), Viladecans and the Balearic Islands (E). All these regions shared an interest in telemedicine and gaining knowledge that could be transferred to local health providers and eventually integrated into urban planning.

The working definition of telemedicine for the project is as follows: Telemedicine is the use of information and communication technology in the primary process of health care (across the continuum) to improve health services (cost reduction, shorter waiting lists) and encourage self-management (better quality of life) [1]. The results of this investigation may affect policy making surrounding health and urban planning.

It is the general perception of the representatives in the INTERREG IIIC Telemedicine Project that health care as a whole and the care of the chronically ill patient in particular needs to take better advantage of state-of-the-art technology. Without the use of IT, lack of communication across the continuum of care results in significant failures in our health care systems [2]. It is believed that a redesign of roles and organisations providing care are also needed to support safer, technology-driven care.

New technological solutions will provide patients with a number of tools that lead to better self-management and a greater awareness of their health condition. Proven disease management tools will lead to improved quality of care, a reduction of hospital admissions, and therefore, a substantial reduction of costs.

The INTERREG IIIC Telemedicine Project will provide an analysis of disease management models with

telemedicine as an important driver in regional health care systems.

As a first step, data was collected on the following subjects:

- The national and regional health care systems of the countries and regions represented by the Project;
- The prevalence Chronic Obstructive Pulmonary Diseases (COPD), Congestive Heart Failure, (CHF) and Diabetes;
- Regional experiences with telemedicine applications to date.

Specific tasks have been assigned to the regions. The city of Eindhoven is responsible for the overall project leadership and will serve as one of the pilot sites. . Southampton will host the second pilot project. Bologna is accountable for the external communication and dissemination of the project results. Villadecans has developed the project web site which includes a public domain and a protected domain for internal project communication. The city of the Hague is responsible for project evaluation.

The project is partly funded under the EU programme INTERREG IIIC. All the participating regions have local teams who will provide expertise in the local health situation and technical environments currently being used. Every four months, one of the participating regions organizes a two-day workshop to discuss the project progress and to conduct detailed work on the next steps in the project.

[1] The participants represent sometimes a region like the regions of Genoa or an actual city like e.g. the Hague or Eindhoven

I. INVENTORY

A. Health care system

It is not surprising that the characteristics of the health care systems represented by the Project vary significantly. This article will not provide an extensive description of the individual systems, but rather, discuss a few of the most remarkable differences. In Italy, for example, regional regulation of healthcare is more common than in the Netherlands or the United Kingdom. In the Netherlands, a new system of health care financing is being implemented known as the DBCs (diagnosis treatment combination) in which a fixed price product is offered for selected diagnoses. In addition, the Netherlands is introducing a new health insurance system in which every inhabitant has a basic insurance package and insurance for additional services can be purchased for an additional cost. In Spain, health care is free of charge and universally available to all citizens. Spain offers a totally decentralised system whereby autonomous regions ("comunidades autonomas") are fully responsible for the health care of the inhabitants of those regions. In addition to this public health sector, there is a private health sector for additional services.

B. Chronic illnesses

The prevalence of chronically ill patients is increasing in all regions. Diabetes, CHF and COPD have a high incidence across all regions. In Spain, for example, 9% of the population between the ages of 40 and 70 suffer from COPD. In the Ligurian region of Italy, the predominance of elderly is placing a strain on the regional health care services where they account for over 2/3 of the overall health care expenditures. In this region, 42% of the population experience heart diseases, 6% COPD and 3% diabetes. In the city of the Hague (NL), about 3,7% of the population suffers from COPD; that is, about 17.000 patients. Of the chronically ill patients in Southampton (UK), the rate for respiratory diseases is approximately 7%, which exceeds the national average by approximately 1%. Heart disease is experienced by approximately 20% of the population as compared to a 10% average nationally. In summary, it is clear that chronic illness command a lot of attention from the existing health care systems.

C. Available telemedicine systems

In all the regions represented by the Project, telemedicine solutions are in use, but solutions that have been proven effective in the areas of COPD, CHF and diabetes do not abound. One solution in use in the Netherlands, the Health Buddy® system, is based on asking the patient to answer a limited amount of questions on a daily basis focused on three main aspects of the disease: patient's knowledge on his/her condition, patient's behaviour and the presence of symptoms. The data are monitored by authorized health care providers at a central location and if needed, actions may be executed.

On a national level, telemedicine applications are available, but are not well-embedded into the existing technical infrastructure. Data are stored in separate systems that lack the ability to exchange data. Based on experiences in the technical domain to date, it is clear that a well-planned IT infrastructure, including the use of communication standards, is warranted such as HL7 v3, DICOM. More generalized the use of the upcoming European standard for electronic health records, the ENV 13606, that uses archetypes as the technical building blocks, should be considered.

II. BEHAVIOR CHANGE: THE MAIN ACTOR

A. Behavioral change

Unhealthy behaviours (poor diet, insufficient exercise, alcohol consumption and smoking) are the most important causes of health problems in Western societies.

Methods for health promotion and behavioural change are often being applied in the area of public health in an attempt to motivate people to pursue a healthier lifestyle. Changing health behaviour is a key component of disease management. However, changing behaviour requires patient willingness and effort, and unfortunately, changes do not generally last over time unless effective long-term strategies are put in place. This explains why so many patients give up which in turn makes it more difficult for them to achieve the desired health goals.

Patient empowerment through the use of IT has been identified as a promising method of achieving behavioral changes and better managing patients' personal health patterns.

Use of an IT application in itself will not change behaviour. It must be accompanied by a willingness to change. Readiness to change usually goes through several stages [3]:

- *pre-contemplation*: the patient is not motivated and doesn't want to think about change
- *contemplation*: the patient starts to think about change
- *preparation for action*: the patient starts to prepare to change
- *action*: the patient shows healthy behaviour and executes certain activities accordingly
- *maintenance*: the patient tries to follow the health rules to avoid pitfalls
- *termination*: the new behaviour has been incorporated and the cycle ends.

This approach to behavioural change has been studied related to behaviours associated with smoking cessation. It serves as an example in this project because many chronic diseases are related to smoking. Some e-health solutions are built upon these stages and support the patient by giving them positive feedback as they progress through the model. Applied to telemedicine, providing information about the consequences of the undesired behaviour in relation to the disease may be helpful to start the process of behavioural change.

B. Self-management

Optimal self-management involves dealing with more than one aspect of the disease on a daily basis. Problems may arise if the patient or the environment does not manage these aspects sufficiently. Kate Lorig describes the differences between old and new care models using a metaphor of someone who falls into a river (a river of diseases). The unfortunate person can be helped in three ways. Firstly, the

person can be pulled out of the water (a traditional care model). Secondly, we can prevent the person from falling into the water (public health). And thirdly, we can teach the person to swim so that he can save himself if he falls into the water (disease management) [4].

Current health care systems are more or less built upon a 'crisis driven' model. If there is a problem, the system 'wakes up' and comes into action. Especially in the area of chronic diseases, this crisis-driven model doesn't work well. This model presents an unwanted situation from the patient perspective – the .patient may require hospitalisation and/or the situation may worsen and cause greater risk for complications down the road. Care providers are often challenged in the care of chronically ill patients due to a lack of technological support for the remote or home monitoring of critical factors in their disease process. Therefore, complications and relapses are not detected in a timely manner and patients are commonly readmitted to the hospital. The INTERREG IIIC Project is striving for solutions that will enhance self-management activities in an effort to influence urban planning.

The traditional model outlined above is a major driver for increasing costs in health care. A higher level of self-management in people with chronic illnesses has been shown to have positive effects in terms of health outcomes and quality of life [5].

An important success factor for optimal self-management in chronically ill patients is appropriate information tailored to their specific disease process with instructions about the stage of illness to support behavioural changes [6].

C. A New Model for Disease Management

Recent studies have shown that a disease management process involving frequent in-home patient monitoring and management has a vast potential to improve quality of care and reduce costs by preventing crises and improving patient education and treatment adherence [7, 8, 9, 10]. With daily in-home patient monitoring and communication, combined with a care coordination process assisted by telemedicine, health care providers can reduce hospital admissions and health care-related costs by detecting and responding to problems before they lead to a crisis. Daily documentation by the patient via on-line questionnaires provide health care providers with the information they need related to the patient's current health status and allow them to track trends over time. The questions are based on national guidelines for the care of chronic diseases.

Applications that provide for provider interaction through remote monitoring of patient symptoms, education of patients regarding their condition, and coaching of patients for improved self-management behaviour have been demonstrated to be the most effective. When intercepted by a nurse or other mid-level provider, selective information can be escalated as deemed appropriate to the patient's physician for additional consultation and possible intervention. This approach empowers patients to be more compliant in managing their condition and documenting their symptoms. Timely provider intervention avoids unnecessary hospitalisations and helps patients to remain living independently in their homes for as long as possible. The goals of this disease management model is optimal medical management, efficient and effective utilisation of health care services, and improved quality of life for patients.

From the perspective of the care provider, the information should be presented in a format that can be quickly analyses prioritised and acted upon. Through the use of telemedicine technology this model provides a patient-provider communication that ultimately improves the quality of care.

With the above described model for disease management, including new guidelines for COPD, diabetes, and heart failure, it is anticipated that at least 20-40% of the chronically ill patient population will achieve the desired benefits within the next 5 years. Based on investigations in the United States it is roughly estimated that cost savings up to € 2 billion annually are achievable [11,12].

III. PILOT PROJECTS

One of the main components of the INTERREG IIIC Telemedicine Project is to document the value of existing telemedicine applications including information and communication technology to improve health care services for chronically ill people and elderly persons at home.

Within this test phase, pilot projects will be carried out in Eindhoven and Southampton. Opportunities for expanding the test phase to other pilot projects in the partner regions are being investigated.The pilot project in Eindhoven will focus on changes in the patient's ability to cope with their chronic illness in their own living environment based on the provision of technology. The Southampton pilot will focus on the impact of these technologies on the architecture and location of housing and health care facilities. The Southampton project will look at heart diseases and Eindhoven will look at patients with diabetes.

Both regions invited several vendors who bring telemedicine solutions to the market in the area of chronic illnesses COPD, CHF or diabetes. The vendors were assessed based on the following criteria:

- *Functionality*:
  - * 12-lead ECG
  - * Single-lead ECG
  - * Heart rate
  - * Blood pressure
  - * Respiration
  - * Glucose measurement
  - * Peak flow
  - * Body weight
  - * Video/speech transmission
- *Technology*
  - + Communication and integration
    - * IT compatibility
    - * Telecare links
    - * Data management
  - + Available media
    - * Land line
    - * Mobile technology
    - * Personal computer
  - + Adherence to standards
  - + Maintenance/servicing
- *Company information*

  * History
  * Staff
  * Prior experiences
  * Country/EU presence
  * Experience with national development projects such as NHS/Las/NICTIZ
  * Pricing models
  * Sponsorship
  * Any other cost

Pressures

- *Clinical activities*
  * Ease of use for clients
  * Ease of use for health professionals
  * Useful results obtained from equipment
  * Usefulness of reports
  * Ease of changing client parameters
  * Improvement in client's quality of life
  * Demonstration of cost reduction:
    - Primary care
    - Social/community care
    - Secondary care

Based on the above criteria, six vendors presented their solutions at each of the two sites.
Each site selected two vendors for inclusion in the pilot projects. The selected vendors had to submit a project plan meeting certain requirements.
The pilots are planned to start in March/April 2006.

IV. Criteria

The pilots will be evaluated according to the following criteria:

- Applicability of telemedicine applications and their effects on the planning of health, medical and housing services;
- Enhancement of efficient planning of medical services in urban areas;
- Improvement the quality of the long-term care to clients both in the community and hospital;
- Improvement the quality of life of patients with chronic diseases;
- Enhancement of the networks that currently exist in the care of older people.
- Existence of a robust database of risk management in order to be able to manage populations as well as individuals;
- Ability to enable the health care services to meet its strategic objectives in providing improved client access, a patient-oriented service aimed at improving self-management and empowerment of patients, improved clinical safety, clinical service goals and clinical governance;
- Services' sustainability to ensure project viability over time including training, technical support;
- Use of proven technologies such as web-based applications and Location Based Technology (LBS) by means of GPS/GSM/GRPS;
- User-friendliness of the solutions in for patients and health care providers;
- Potential for an increase in the number of clients treated;
- Reduction of the number of unnecessary admissions to hospital;
- Reduction of the number of unnecessary visits to hospital;
- Reduction of the number of unnecessary visits to the GP;
- Reduction of the number of unnecessary visits of professionals to patients (home health care);
- Decrease of the length of stay at the hospital;
- Decrease of actual or potential life threatening adverse conditions;
- Optimisation of drug therapy for clients (compliance);
- Improvement of cost effectiveness of the services to older people and those with chronic conditions;
- Optimisation of patient satisfaction with regard to self-management.

These criteria will be investigated by the team from the city of the Hague. Propelled by the developments in Southampton and Eindhoven, the other regions involved in the Project also see very good opportunities to set up telemedicine pilots in their regions. The first investigations of opportunities have been done and all the regions are working on project plans for telemedicine implementations in their own region. In addition, it was very interesting to observe vendors collaborating more closely as a result of their participation in this Project to boost technical solutions which meet the needs of the regions.

V. Implementation plan

In order to support the local implementations, an extensive implementation model has been developed. All the important steps needed to ensure a successful implementation were put in a flow chart including high level criteria. This paper will describe the following aspects outlined in the flow chart:

- Detection of areas of opportunities including assessment of needs
- Development of a business case and use of best practices
- Organization the relationships between all the stakeholders involved (e.g., force fields)
- Embedding organization, content and technique
- Transform the primary health care processes
- Collaboration in a virtual organization.

It is important to understand that the mission and vision of the organization are the basis of the development of a business

Figure 1. First part of the implementation flow chart

case. Without a clear and adopted mission and vision, a business case cannot be developed.

VI. Conclusions

The INTERREG IIIC Project started with the initiative of the city of Eindhoven (Municipal Public Health Services). Six additional European regions joined the Project because of comparable problems in the management of chronic illnesses in their regions. All the participating regions have demands for urban planning. Plans for the development of health care facilities to care for the increasing number of chronically ill patients are limited. Technology itself will not change health care. Redesign of health care processes is essential. The patient, ultimately, will need to be empowered to take a more leading role in their own health care necessitating better training in self-management Enabling patients to maintain their health care within their own home through the use of

technology solutions will be a critical component to improved self-management. The exchange of high-level expertise and experiences among the project participants has propelled the deployment of several telemedicine pilots that are showing promising results.

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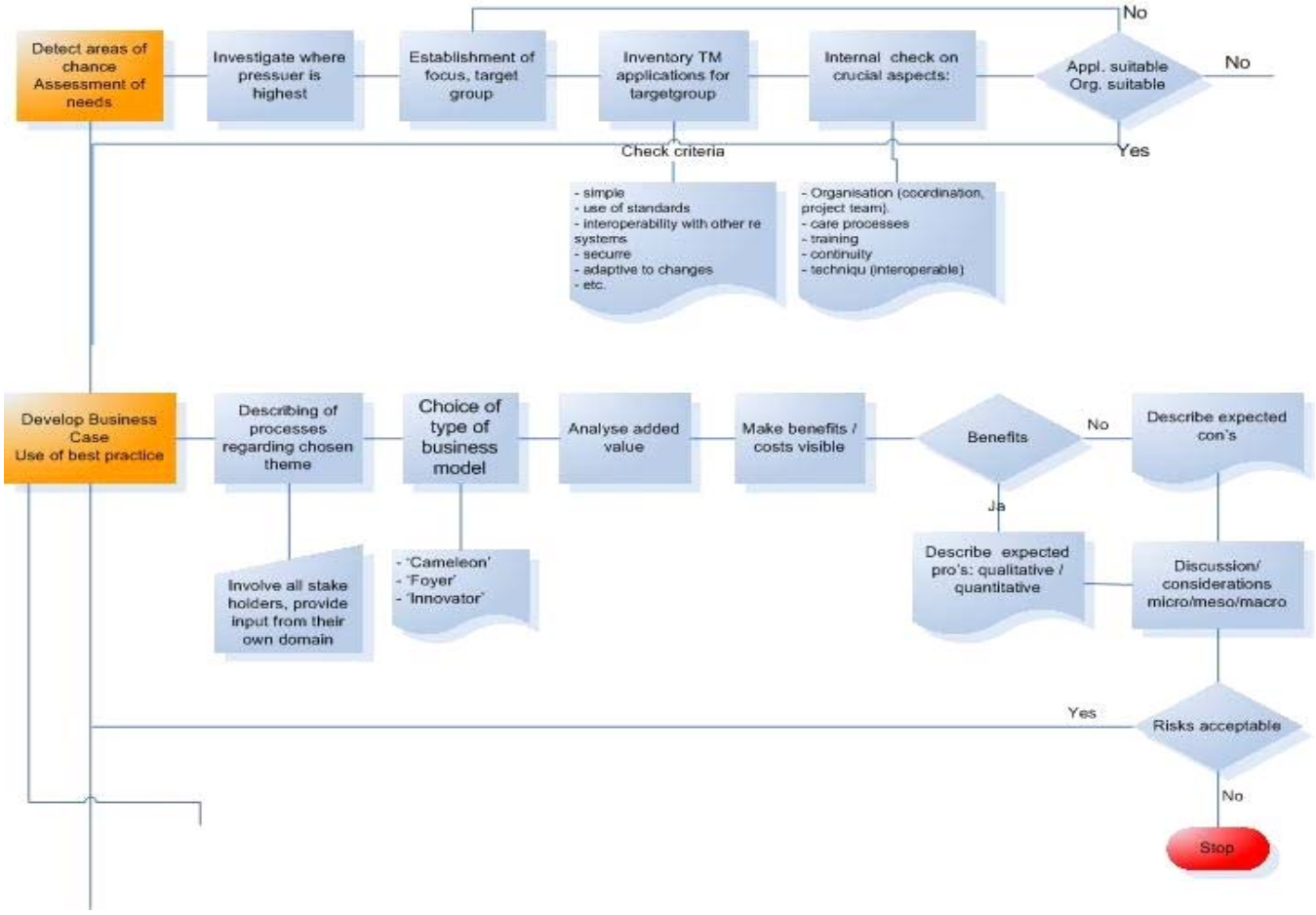

New Ways in Telemedicine – Experience Of 2005

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Abstract - We made steps in development of new directions in the telemedicine (in 2005): mobile telemedicine for urgent teleconsultations of injuried; low-cost telemedicine for rural areas; home telemonitoring.

I. Introduction and Aim

The modern telemedicine use a lot of technological and telecommunication decisions, which allows to achieve mobility, interoperability, clinical and non-clinical efficiency [11]. We undertake steps in development of new directions in the telemedicine (in 2005).

Aim of the paper – presentation of first results of usage of new telemedicine directions: mobile telemedicine, telemedicine decisions for rural areas, home telemedicine.

II. Materials and Methods

Materials: telemedicine work stations (room unit - PC, digital camera (~3 mpxl), scanner, printer, audio set, dial-up Internet, mobile unit – PDA/mobile phone. digital photo-videocamera (0,3 mpxl), GPRS Internet); Melexis™ system for blood pressure and heart rate home telemonitoring; Best practice models of ISfTeH; web-platform iPath.

Methods: synchronous and synchronous teleconsultations, home telemonitoring, analytical analysis, investigation of moral efficiency, investigation of diagnostic and treatment activity, outcomes efficiency.

III. Results

Mobile telemedicine

Classical mobile telemedicine means usage of portable mobile computer sets with medical equipment and satellite links. Such systems usually use in military medicine, during technological and ecological disasters, on transport. By the other hand, the modern medical doctor is very active in daily clinical practice. So, the new conception of mobile telemedicine means quickly, easy and useful access to telemedical technologies during needable time, in needable place. The telemedicine should be in the pocket of the doctor's dressing gown near to stethoscope, pencil or scalpel. Development and wide improvement of mobile technologies (PDAs, smart- and camera phones, communicators, GPRS Internet etc) allows medical doctors to be on-line 24 hours per day. It is system for "telemedicine in dressing gown's pocket" - anytime and anywhere (ward yard, surgery room, car etc) medical doctor can lead telemedical procedure [3,5] (fig.1).

In 2005 first time in Ukraine we were used urgent synhronous teleconsultations for patients with acute traumas [10]. It was carried out 9 urgent teleconsultations (patients: male - 6, female – 3; age 9-40 years).

Diagnosies: serious isolated trauma – 56%, polytrauma – 22%, maxillo-fascial trauma – 22%.

Technologies: scheme "MMS+E-mail" (2 times), mobile phones' servicies (2 times), e-mail (3 times), mailing lists (2 times).

All advices had high relevancy (especially when we were used professional mailing list). But, in urgent cases the time factor is very important.

Median time between request for teleconsultation and receiving of advices: scheme "MMS+E-mail" – 25 min., mobile phones' servicies (MMS/SMS+voice+GPRS) – 15 min., e-mail – 360 min, mailing lists – 30 min.

From professional mailing list we were received very good advices, but we can be sure about time factor. E-mail (direct request to expert) is not very effective, because for urgent cases it is need to create call-centre.

Mobile phones' servicies (like MMS/SMS messagies, GPRS Internet) with e-mail and integration of mobile devices (PDA, smartphones etc) looks like most effective tool for urgent teleconsultations, because:

- possibilities for fast excahnge of medical information and images;
- possibilities to find expert any time and any place (real mobility of the telemedicine);
- economical effeciency (cheap devices and communications, better results of treatment, no special workers and centres).

For preservation of the patients right we were used information consent and anonimity.

Figure 1. Mobile telemedicine at the base of PDA, smartphone and GPRS Internet

Telemedicine for rural areas

In many countries of the world quality of medical care in the remote and rural areas remains on the low level. It is

possible to tell, that the rural doctor remains the basic consumer of telemedical services (fig.2). So, development of special decisions' sets is necessary for most effective improvement of the telemedicine in rural areas [6,12].

Our recommendations on self experience:

1) Telemedical work stations (PC, digital camera, dial-up Internet).

2) Mobile phones with message services (MMS/SMS) and digital cameras, especially for urgent teleconsultations.

3) GPRS Internet is an effective alternative to usual links. Because, in the remote rural areas quality of ground telephone communication lines very low also does not allow to use dial-up; leased lines usually are very expensive.

4) Using of web-platforms for teleconsultations (for example, iPath of Basel University is used as the web-platform for the Donetsk Regional Telemedical Network; iPath is a web-based, open source telemedicine platform developed at the University of Basel since 2001; the iPath platform combines communication with content management features and its main function is the "medical discussion group" in which a defined group of users can present and discuss clinical cases) [1,2].

We were organized telemedical network, which include:

- trauma subnetwork (regional center and 3 remote station in rural areas, 30 teleconsultations were lead per year);
- tuberculosis subnetwork (regional center and 4 remote station in rural areas, teleconsultations were lead per first months).

Figure 2. Teleconsultation of injuried from rural hospital

Basic barrier in the way of the rural telemedicine is the human factor:

- low level of computer literacy and possession of foreign languages;
- fear of new;
- unwillingness to share "secrets of skill ", etc.

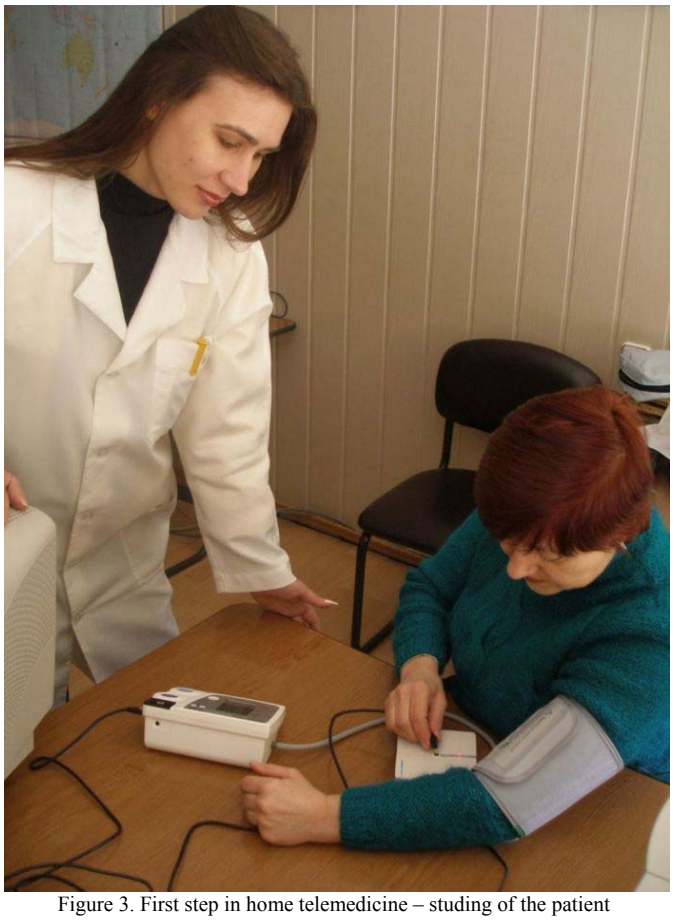

Figure 3. First step in home telemedicine – studing of the patient

By our opinion, technical and financial problems to overcome much easier, than human denying of eHealth technologies. Often we should see telemedical workstations which become covered by a dust in the thrown offices. There are technologies, money, experts, Internet, but there is no desire. So, we believe, that is necessary to spend a plenty of various events (conference, seminars, schools, etc.), devoted to telemedicine and eHealth. Also it is needable to organize the special company in mass-media for popularization of telemedicine for patients and for doctors.

Home telemedicine

Development and improvement of home telemedicine – one of the most important directions of modern eHealth.

First time in Ukraine we were used system for blood pressure (BP) and heart rate home telemonitoring kindly given to us Melexis™ company. System consist from: BP monitor, I-modem, ROS-server.

We had been organized experimental (trial) home telemonitoring for 7 patients with hypertension and orthopedics diseases. For investigation of moral efficiency we were developed special questionnairy (fig.3).

Attention - at present (trial) stage the system was not used for diagnostics and treatment!

IV. Conclusion

1. Mobile telemedicine "in dressing gown's pocket" allows to provide effective and fast teleconsultations. We believe that optimal sheme for urgent teleconsultations for acute trauma at hospital stage consist from: telemedical work stations at the base of mobile computers with in-build digital camers (PDA, smartphone, communicator etc); general telecommunication lines (Internet, GPRS, mobile telephone etc); protocols and standards; best technology: "Mobile servicies (MMS/SMS/voice)+E-mail". Urgent teleconsultations for acute trauma are very effective because: fast advices of expert (maxillo-fascial surgeon, neurosurgeon, specialist in pelvis trauma etc); fast choice of most effective surgery; best treatment results; possibilities for telemonitoring during a few next days. There are necessity for development of special protocols and standards for urgent teleconsultations. We will continue our telemedicine activity in this field for more statistically valuable results.

2. We were developed sets of decisions for rural telemedicine:

- simple and cheap telemedical work stations (PC, digital camera, dial-up Internet);
- mobile smartphones and PDAs for urgent teleconsultations;
- GPRS as an effective alternative to usual links;
- web-platforms for teleconsultations.

Ethical, law, economical, clinical decisions had been created by us earlier [4,7-9].

Teleconsultations in framework of Donetsk Regional Telemedicine Network has high relevancy and effectiveness.

3. Home telemedicine is very prospect tool. Research of patients' satisfaction of home blood pressure telemonitoring system has shown a high moral effectiveness. We will continue our telemedicine activity in this field for more statistically valuable results and investigation of clinical outcomes.

Acknowledgment

We are very appreciate to Melexis™ company for home telemonitoring system and Department of Pathology, University of Basel, Switzerland for iPath web-platform.

More information: www.telemed.org.ua, http://telemed.ipath.ch, www.melexis.nl.

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E-Health in Developing Countries: Moldovan Experience

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Abstract- Implementing information-communication technologies in health care is an effective way of solving various problems of management, diagnostics and treatment in developing countries. In Moldova, after studying the best practices and most efficient models used worldwide the National Conception of Medical Integrated System was elaborated. This National Conception laid the foundation for all the projects dealing with IT in health care. Moldova chose the way of developing a basic informational platform – electronic medical records, the structure of which allows expanding and replicating, depending on the field used.

At present, following the Conception of Medical Integrated System, a project, dealing with the creation of a National network of perinatological services, has been launched successfully.

I. INTRODUCTION

Nowadays the progress in Public Health can be achieved only by means of introduction into healthcare practice of up-to-date scientific inventions, by use of new ways and technologies in branch management, including the information-communication technologies (IT). The widespread adoption of information technologies in the medicine and healthcare developed at the frontier of centuries a new kind of healthcare – electronic healthcare (eHealth).

As used here "eHealth is a new term used to describe the combined use of electronic communication and information technology in the health sector" OR "is the use, in the health sector, of digital data-transmitted, stored and retrieved electronically – for clinical, educational and administrative purposes, both at the local site and at a distance".[1]

Today the improvement of technical professionalism may be observed in developing countries, including in the field of information technologies. Moldova is no exception in this regard. Therefore, they may count on certain successes in case of adopting information technologies in the Public Health.

However, in many of the countries a lot of expected benefits from use of IT in the healthcare have not been implemented yet. One of the major causes is the non-coordination of actions and lack of a common development strategy for eHealth as a whole. Therefore, for the elaboration of the profitable applied models, specifically, for the comprehension of factors, that determines the efficiency and stability of eHealth projects, it is required coordination and integration of various organizations, concerned with and having need of introduction of IT into healthcare.

II. NATIONAL SYSTEM OF EHEALTH AND TELEMEDICINE

D. Purpose of eHealth application in Moldova

The benefits, provided by the IT application in Public Health, are various. [2, 6] In Moldova the eHealth application purposes are as follows:

- Providing medical data to the medical specialists and other users via telecommunication channels and Internet;
- Creating premises for getting objective data of healthcare condition;
- Creating premises for improvement of professional qualification of medical staff;
- Ensuring the «transparency» of the activity of public medical institutions.

The IT application in the Moldovan healthcare within a short period of time passed through several stages; their successful implementation allows us to count on certain progress in this field.

At the first stage, the establishments most concerned with eHealth-projects were figured out, among which the following are to be mentioned:

- Ministry of Health and Social Protection
- National Medical Insurance Company
- State Medical and Pharmacy University
- Ministry of Information Development
- Drag Agency

At the same time, the researches of the most successful and acceptable models for eHealth programs and telemedicine

worldwide were conducted. [3, 4, 5, 7] The adoption of such programs and concepts for IT application into healthcare was carried out in many countries worldwide. We have to mention, the main disadvantage of most projects, in our opinion, is the separate application of single modules and tendencies, being of certain interest for various groups of healthcare professionals or local healthcare structures. [6, 8]

E. Preliminary conditions

An important stage was the in-depth analysis of the conditions and opportunities for development of information technologies in the healthcare. Among the most important ones are to be mentioned:

- The low level of IT use in the public medical institutions.
- Availability of the system of state electronic registries, as basic platform, allowing the low cost use of such information in other fields;
- The Ministry of Information Development was founded in Moldova; it carries out the coordination of IT application in many fields of national economy, defending above all the interests of state authorities;
- Adopting of National program of development of Information society; the healthcare informatization is a part of it.

Taking into consideration these preliminary conditions, predominantly by means of Ministry of Information Development and under its initiative the planned IT elaboration and application into healthcare was put into practice.

As a result the Concept of Integrated Medical Information System was elaborated and adopted. This Concept became the key guide for putting of all eHealth-projects across Moldova into practice (Figure 1). The Concept provides the elaboration of unified platform for realization of IT projects in various fields of Moldovan healthcare. Such a technological solution was the working up of electronic medical record (EMR), whose configuration may be changed according to given tasks and projects.

Figure 1. Model of Integrated Medical Information System.

For Moldova, as a small state, this Concept means the creation of a National healthcare information system, in form of a Medical Information System for the public medical institutions. By such formulation of question the issue of standardization and interoperability of various systems becomes insignificant, since in all public medical institutions the application of united technological platform – EMR is foreseen.

III. IT-PROJECTS IN PUBLIC HEALTH

One of the first practical projects was the working up and application of the computer-based system for information providing and efficient functioning of the National Company of Compulsory Medical Insurance in Moldova. This program purposes not only ensuring of the efficient monitoring of spending the bankroll but also setting up the foundation for elaboration of efficient mechanisms for updating the entire system of medical care at different stages of healthcare services. This project utilizes EMR as the basic module, where the primary data is recorded and stored: about patients, healthcare services, diagnosis, etc. Also, it is very important the use of personal identification code – **IDNP** – a mechanism that allows identifying any person throughout Moldova, consequently, to make a link between the medical attendance services of any healthcare institution and the patient, to whom this service is rendered.

At present the stage of application of this system throughout Moldova and setting up the unified database of medical care services, rendered to population, comes to end.

The next state-level stage was the setting up of the system of automated registration of pharmaceutical products and drugs in Moldova. This project is a part of the general strategy of healthcare informatization and purposes ensuring the legality and transparency in the market of pharmaceutical products, also to guarantee the quality of pharmaceutical products at all stages, starting with manufacture and import through retailing in drugstores. The project was launched at the end of 2005 and its deadline is set in 2008.

The most important and large-scale part of the Program of healthcare informatization is the elaboration and application of medical information systems for public medical institutions. This element of the whole system will form the basis for the setting up of the National healthcare information network. This will be the most difficult and time-taking part of the entire program, as the initial level of informatization in the public medical institutions is very low. Over several past years in Moldova attempts of application of medical information systems for public medical institutions have been made, but they were not systematized and had no large-scale character.

Two projects have been launched in the current year: the elaboration of medical information systems for the Primary Care and setting up the medical information systems for the Mother's and Child's Care. The given projects become a basic platform for creation of specialized programs on introduction of IT for Primary Care and Perinatology as most important part of Public Health in Moldova.

IV. CONCLUSION

Moldova has chosen the long and uneasy path of healthcare update. The IT application into healthcare is an essential and unavoidable part of the whole process. The results achieved so far encourage the success forecast in this respect.

The state authorities have the opportunity to apply the eHealth technologies and the telemedicine as a tool for collecting information and learning the requirements to the medical care, in particular, to apply eHealth and the telemedicine in the general arrangements for the development of healthcare, education, carrying out research programs of healthcare and the expansion of telecommunications. As soon as they become technologies immediately useful for the healthcare, eHealth and telemedicine will enhance the access to the medical care; will contribute to the setting up of National healthcare system.

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Ambulance Network Layer of Telecardiological System for Patients with Acute Coronary Syndromes in Mazovia District of Poland

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The ambulance network layer and ECG transmission directly from the ambulance to the reference invasive cardiology center is described for patients with Acute Coronary Syndromes (ACS). It is considered the key component of a telecardiological system which shortens the time from the first contact with medical team to intervention and improves the access to care for patients from little towns and rural areas.AIM

The aim of system implementation is the improvement of quality of care and access to care especially for patients with acute coronary syndromes (ACS) from little towns and rural areas. The care should comply with the European Society of Cardiology (ESC) guidelines [1,2] which means that within 90 minutes from the first contact with medical team the patient should have the interventional cardiological procedure. Map of Mazovia District with 2 reference centers is presented on figure (Fig. 1). List of regional centers participating in the system from the Western part of the District is presented in table I.

Table I. LIST OF CENTERS PARTICIPATING IN SYSTEM WITH NUMBERS OF AMBULANCES

Regional center	Number of ambulances
Sierpc	1
Plock	4
Plonsk	1
Raciaz	1
Wyszogrod	1
Gostynin	2
Gabin	1
Sochaczew	3
Blonie	1
Pruszkow	3
Grojec	2
Rawa Mazowiecka	2
Sum	22

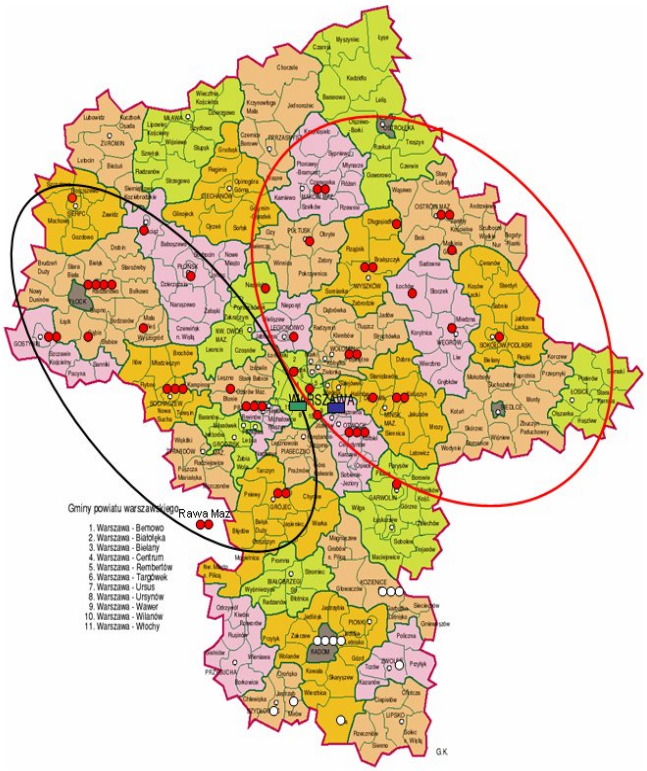
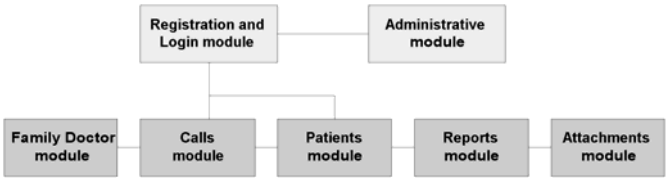


Figure 1. Map of Mazovia District with centers included in network (left elipse – region of 1-st. Cardiology Clinic, Medical University of Warsaw, right elipse – region of the Institute of Cardiology).

Pilot program carried out in the Eastern part of Mazovia District [3] had shown that direct transport in polish conditions is possible, safe, improves access to invasive cardiological treatment and shortens the time from the first contact with medical team to primary angioplasty. In order to demonstrate clinical and economical advantages it is necessary to disseminate that program into wider area of the District and to the country what is exactly the aim of our study.

I. METHODS

The overall structure of the system consists of 3 layers: 1– reference (invasive cardiology) center, 2 – regional centers (hospitals), 3 – ambulance network. The software tools for communication among centers are Electronic Patient Record



(EPR), accessible via Internet, relational data base MySQL in which EPR's are stored and expert system (ES) for risk assessment and advice on non-pharmacological and pharmacological treatment.

The EPR is based on client-server architecture (Fig. 2).The EPR is implemented on a separate server, dedicated especially for operation under Linux system [4, 5]. The Web server should have the PHP module to the database server (Apache). This means that the PHP tool is built into the WWW server, which helps to search the website. It is a combination of the programming language and the application server. For building EPR archives the relational database server MySQL was used. Its advantages are simplicity, high efficiency at low software requirements and speed of operation. It uses well known query language SQL. Several tools for creating EPR: PHP, HTML, XML and Java Script [6, 7] were used.

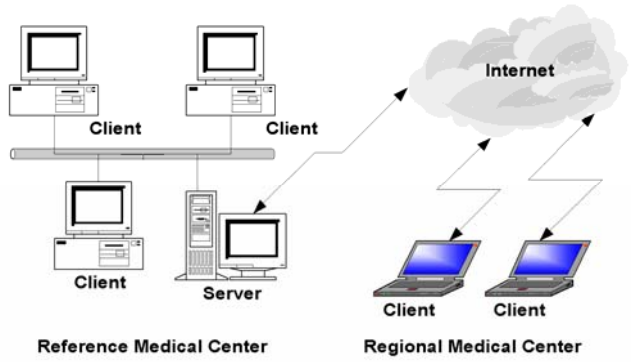


Figure 2. Structure of client-server EPR application in telecardiological system.

EPR application has WWW interface. For operating it the acquaintance of Internet is sufficient. Doctor who is logging into the system is being authorized, and next from WWW site level he has access to data and results of patients' examinations from his own medical center. On this site a doctor has the possibility of filling the electronic forms with personal data and medical data. The history of the patient's disease is automatically generated. The structure of EPR is shown in figure 3 (Fig. 3).

Figure 3. Structure of electronic patient record (EPR).

EPR application consists of several modules: Administrative, Registration and Login, Calls and Patients, Reports, Family Doctor as well as Attachments.

The two main modules are calls and Patients. The first one Calls is designed for fast transfer of medical data from regional centers to reference centers. Its main task is to support decision making related to patients who need help at once, which means whether the patient is to be treated in a regional or reference center. This module contains a minimal number of forms to be sent to the data base. After performing these activities, SMS message is sent simultaneously to the physician on duty in the reference center. This physician has a duty to check the record of the patient which number has been sent to his phone. Decisions made according to the EPR will influence further procedures related to the patient.

The second module Patients is dedicated to physicians in regional centers as well as those in a reference center. Its main task is to collect detailed medical data about the patients. The work with two modules Calls and Patients is similar. In some forms there is a possibility of adding multiple new observations during one hospitalization (it applies only to forms in Patients module). Data from these forms are written down in the EPR data base. After filling the user can look through the whole record of the patient by clicking Browse link on the record page.

Apart from reviewing EPR the physician has the possibility to print it by clicking Print option. This option is accessible on every page of application, which facilitates printing the forms as well as getting familiar with them. The module of adding the files of different formats is implemented in several forms (eg. ECG).

In menu, different modules are visible such as: Reports, Family Doctor and Attachments.

Reports module is designed to report the daily history of events for every patient. Family Doctor allows for addition of new family doctors to the system.

The module Attachments is connected with adding the ECG files to the database. We can use it both from menu panel and directly from forms.

Due to easy presentation of data in a formalized form with the usage of XML (Extensible Markup Language), as well as its perfect cooperation with databases – it has a very important meaning in EPR. XML file, apart from possibility of displaying it in Internet browser, is a starting point for introducing the communication standard of medical textual data HL7 [8,9].

The database is a relational database. The basic property of such database is that the data is stored in tables with defined relations among them. All tables in am_ehc are designed in such a way that there is no redundant information [10,11]. Tables are used for collection and storage of data from medical questionnaires and are divided in 3 groups:

- for data storage
- for data presentation
- for identifiers defining the possibility of entering the data once again from medical questionnaires.

A global administrator main task is to take care of the server with regard to software timeliness. Proper configuration and error free software make the server safe and secure. Standard administrator tasks, including creating

backups, changes in system configuration etc., establish the foundation of the internet site secure system.

The main place to execute administrator activities in the Electronic Patient Record is the administrative panel. It is a place where operations like conferring authorizations upon using the EPR database, removing user accounts, which are no longer using the system, removing old and useless files or incomplete medical records are carried out. Another part of database administration is conferring authorizations upon users working with EPR system. These authorizations were divided into groups with regard to the type of the user. Possibility of removing patients' medical records is reserved only to the user called administrator. Next two groups: resident and physician personnel have the rights to add, edit and review only these patients' medical records, whose data they introduced. The last group-guests, is created for students and third persons who may only review anonymous patients' records without rights to modify them.

To achieve the aim of better access to and quality of care certain organizational and technical conditions must be fulfilled. The network of ambulances (3-rd layer) should be available with the equipment for transmitting ECG signal from the ambulance via cellular phone to the central receiving station (Medtronic) located in the reference centre/hospital.

The system for 12 lead ECG transmission consists of the LIFENET RS receiving station (cardiology center), LIFEPAK 12 defibrillator (ambulances) and mobile phones.

2 telephone calls from the ambulance routinely take place: first before transmission and second call after transmission. During the second call transport possibility and eventual pharmacological treatment of the patient are discussed. We developed previously the cardiological database and EPR for the patients with ACS which can be accessed from regional hospitals via Internet. Next step is the integration of central receiving station and the EPR database in order to store and integrate the data obtained from the ambulances with the data from the hospitals.

II. RESULTS

The process of sending the ECG signal directly from ambulances via cellular phones has started recently. Few transmissions have taken place. The received ECG signal is of a very good quality comparable to that obtained when the ECG is acquired in the reference center. The main criterion for qualifying the patient for angioplasty is ST segment elevation. The data of more than 100 ACS patients were collected in the database before starting ECG transmissions. Example of ECG is presented (Fig. 4).

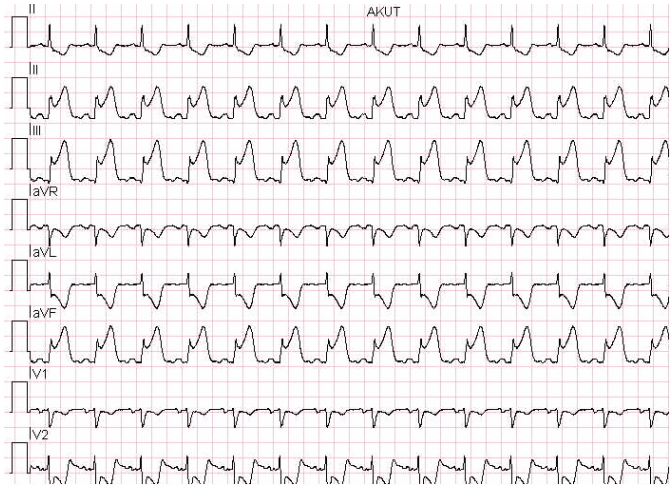


Figure 4. Example of ECG report transmitted from regional hospital to reference centre.

The standard of pharmacotherapy for ACS patients is implemented in ambulances. Using that standard the action time delay of such drugs as acetylsalicylic acid, clopidogrel and heparine can be avoided what can have effect on clinical results.

III. CONCLUSIONS

- The key component of a system – ambulance network and direct transmissions of the ECG signal from ambulances to the central station, is working well and is a good tool for decision making regarding invasive cardiology procedure. It enables the transport of ACS patient directly to the reference, invasive cardiology center without referring the patient to the regional hospital which causes time delay. Thus the compliance with ESC guidelines can be achieved.
- The EPR database access is useful also during recovery of the patient in the regional hospital. It gives the possibility of performing more invasive cardiology procedures in the reference center as the patient stays there for a shorter period of time.
- The intensive training of the ambulance crews and also staff operating the central receiving station is an important factor.

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Session 12

Space Technology as a Tool for Delivery e-Health

Satellites and Health Early Warning for Environmental Risks

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It has been definitively demonstrated that some important health outcomes are tightly associated with environment, weather, and/or climate.

Among these are temperature-related morbidity and mortality, health effects of extreme weather events (storms, volcanoes, earthquakes, floods, droughts), air-pollution-related health effects, water- and food-borne diseases, and vector- and rodent-borne diseases.

In order to predict and prevent these health threats, monitoring the environment and climate parameters and changes from the space is becoming mandatory.

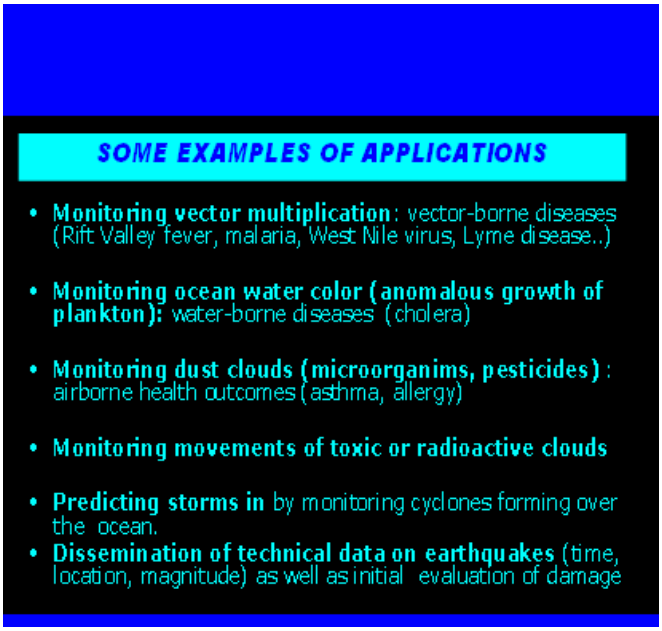
KEY ADVANTAGES IN USING SATELLITES IN EWS

1.- Large amount of data obtained from the **permanent monitoring** of the environment via SAT. Possibility of integrating these data and complementary data in predictive models to study communicable disease transmission and extreme meteorological event patterns and trends

2.- Possibility of **predicting** outbreaks/natural disasters in **specific areas within times compatible** with the preparation of an adequate response. Other EWS can detect "current" emergencies to prevent undesiderable consequences and diffusion but can hardly predict them.

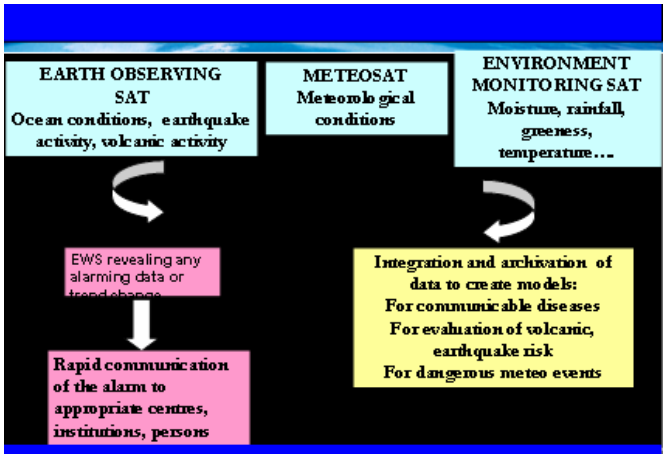
3.- Development of a **growing database** which will provide future generations with **increasingly accurate predictability**

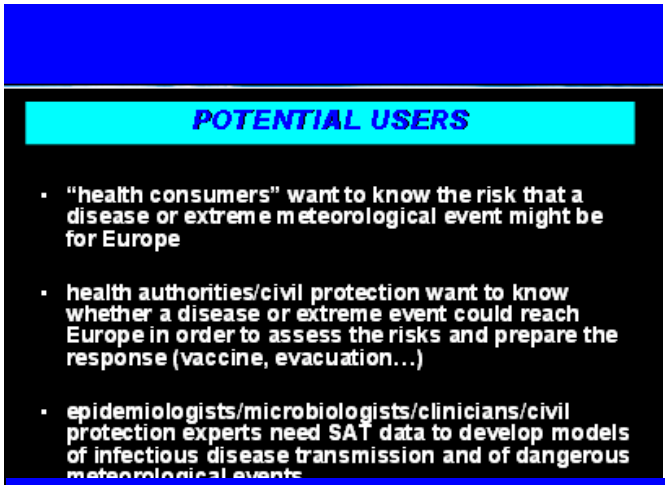
4.- Possibility of **large coverage, including isolated, remote areas** which would otherwise not be monitored and allowing equal access.

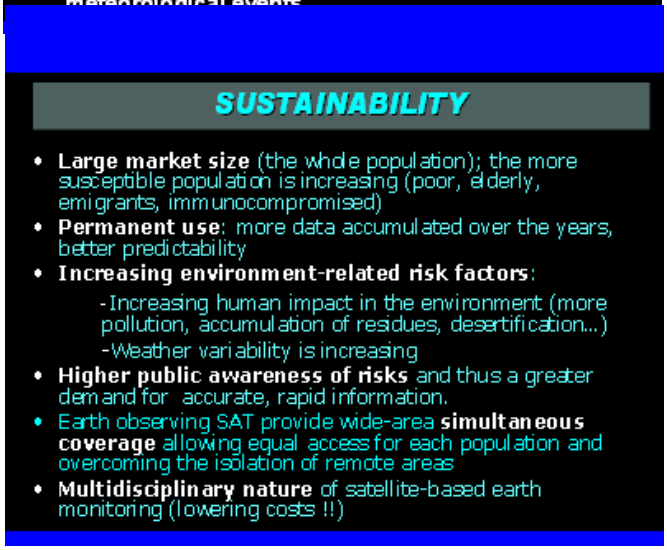


The high amount of data provided by satellites can be used to set up H-EWSs capable of revealing any alarming data or changing trends and of rapidly communicating the alarm for adequate targets (centres, institutions, stakeholders). Satellite technologies can also be used in H-EWS to centralise, make accessible and deliver databases to public health bodies, decision makers, and health information centres.

Moreover, data obtained by satellites can be integrated with other data (epidemiological, veterinarian, clinical) to feed mathematical predictive models in order to forecasting risks of infectious disease outbreaks







CONCLUSSIONS

The **use of satellites is mandatory** to create an Early Warning System capable of predicting communicable disease diffusion patterns, risk of disease outbreaks and extreme meteorological event related health threats on the basis of an enlarging database constructed by continuously monitoring the environment.

Moreover, the **transmission, in real time, of alarming data via satellite** would allow prediction to occur in times compatible with the setup of adequate protective measures for the safeguard of the citizens' health.

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Strategy towards Sustainable Services in Tele-Health and Tele-Epidemiology

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Abstract- Since 1999, CNES in the frame of the S2E consortium (Space Survey for Epidemies, gathering CNES, MEDIAS, MEDES, CLS, Institut Pasteur and Ecole Vétérinaire de Lyon) has been working with health professionals to consider how space-based systems could improve health care, notably through telemedicine applications. Potential users have identified two key areas: teleconsultation to ensure good-quality diagnosis for extremely isolated populations, and tele-epidemiology to combat deadly viruses and disease. Today, many case studies have proven the value and effectiveness of such systems:

- TELECONSULTATION

A number of space-based telemedicine networks have been set up recently to provide teleconsultations in dermatology, emergencies and tropical medicine. In French Guiana, a pilot experiment was conducted from end 2001 to the spring of 2002, with funding from the Ministry of Health, by Andrée Rosemont hospital in Cayenne and CNES, in close cooperation with MEDES, . Four health clinics at isolated spots in the Amazon jungle were supplied with telemedicine kits to be able to send imagery and digitized tests via satellite for dermatology, cardiology and tropical medicine. The results were so encouraging that the four sites have been made permanent, and the Ministry of Health and the European Regional Development Fund are providing funding to equip all of the 21 clinics linked to Cayenne hospital with a telemedicine kit.

Looking ahead, other telemedicine projects are in preparation. For example, the Ministry of Health has commissioned a study to deploy telemedicine systems in all of France's overseas territories and dependencies (French Polynesia, New Caledonia, etc.) and those countries for whose health policy it is responsible (Madagascar, Seychelles, Rodrigue, etc.). Projects concerning medical emergencies in ambulances or during natural and man-made disasters are also being considered as part of ESA's DELTASS initiative (Disaster Emergency Logistic Telemedicine Advanced Satellite System).

- TELE-EPIDEMIOLOGY

Tele-epidemiology consists in studying human and animal epidemics, the spread of which is closely tied to environmental factors. By combining vegetation index data from SPOT, meteorological data (winds and cloud masses) from Meteosat, and other Earth observation data from Topex/Poseidon and Envisat (wave height, ocean temperature and colour) with clinical data from humans and animals (clinical cases and serum use) and hydrology data (number and distribution of lakes, water levels in rivers and reservoirs), we can construct predictive mathematical models. A number of such approaches have been tested in the last three years. In Senegal, Rift Valley fever epidemics are being monitored in all risk zones in which the population and cattle are exposed.

In French Guiana, a tele-epidemiology network was set up in mid-2003 to monitor hemorrhagic dengue fever.

As part of the French Ministry of Research's Earth-Space Network, a pilot sentinel network has been deployed in Niger and Burkina-Faso to monitor infectious diseases whose spread is tied to environmental factors.

Today, these projects are operational, operated and funded directly by the users.

Teleconsultation and tele-epidemiology prove that existing resources—satellites, medical kits, infrastructures and so forth—can be exploited to improve quality of treatment, particularly where environmental conditions are precarious, and achieve significant savings in public health costs. Ground-based data collection and transmission networks supported by satellite imagery can play a vital role in preventing the spread of diseases due to environmental factors. And epidemic monitoring networks can be a first step toward a European health early-warning system, as suggested by the European Commission and voted by the European Parliament.

1. INTRODUCTION

The goal of this paper is to present CNES activities in Health, and the strategy developed by Application and Valorisation Department at CNES in term of technology transfer to ease creation of new services in tele-health and tele-epidemiology.

2. SATELLITES AND HEALTH

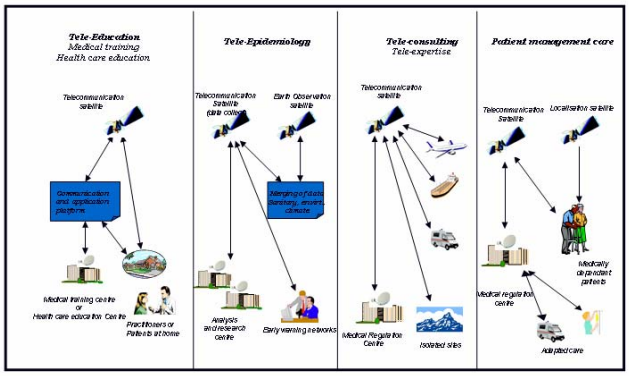

Figure 1 . Satellites and health applications

Various types of satellites can contribute to providing services in different health domains.

- Communication satellites can be used to establish a direct link between isolated sites and central hospital, in order to exchange expertise for a diagnostic and decide of the opportunity to evacuate a person or not. This can lead to sustainable financial gains.
- Data collecting satellites can be used to collect data all over the world, and transmit them to users in near real time.
- Remote sensing satellites for earth observation, oceanographic altimetry, with on board optical or radar sensors, scatterometers, lidars, radiometers, can contribute to environmental and climatical parameters observation.
- Navigation satellites can contribute to geo-locallisation.

Satellite contribution has to be understood as a tool, in addition to existing ones. They can be operated in complement with terrestrial infrastructures to provide 24/24h services.

2. ORGANISATION AND STRATEGY

2.1 *CNES ORGANISATION*

Since its re-organisation in 2003, Application and Valorisation Department is part of the Directorate for Strategy, Programs, Innovation and Foreign Affairs. Its new position in the CNES organisation is the will to strengthen the use of space techniques in new domains, and to address government concern in sustainable development, especially in health.

Actually, Application and Valorisation Department gathers under Dr Guell management:

- 6 persons in charge of Valorisation, econometry, licences and outreach, innovation and start-up supporting,
- 2 persons in charge of Applications development in the domains of Risk management, Tele-epidemiology.
- 1 person incharge of relations with EC.

The persons in charge of valorisation are in relation with their correspondents of the valorisation network of CNES Toulouse technical centre and with the industrial partners.

The persons in charge of applications development are in relation with scientific and industrial partners.

All these persons contribute to the outcome of new ideas and projects, as a bidder or as a relay. When an idea gets a good evaluation mark, then CNES supports it on a 50/50 funding approach from its very beginning until its demonstration. After the demonstration phase, users are invited to take over CNES to ensure the complete funding of the operational service. Between the demonstration phase and the operational phase, CNES can contribute to the creation of a service provider to ensure the sustainability of the service.

2.2 *S2E CONSORTIUM*

Concerning the Applications development in the domain of health, and in tele-epidemiology especially, consortium S2E (Space Survey for Epidemies) gathers several partners from various domains:

- CNES, space techniques and applications development,
- MEDIAS, information system and database, metadata, remote sensing new products dedicated for epidemiology,
- MEDES, information system, data collection and users interface,
- ENVL (Ecole Vétérinaire de Lyon), mathematical modelling,
- Institut Pasteur, virology, molecular bio-analysis, biology, CIBU (Biological Crisis Intervention Unit)

A first agreement was signed in 2001 for a duration of 4 years. Actually, this agreement is being reviewed in terms of partners, contributions and objectives.

S2E consortium has supported several projects, and some are undergoing. Good results have been obtained. The partners are interested in contributing to S2E follow-on.

S2E consortium outreach has to be developed to provide scientific and user community with its achievements.

A S2E "offer" is being developed, and discussions are undergoing between partners in order to define the most appropriate model for S2E as a moral and economical entity.

2.3 *STRATEGY AND TECHNOLOGY TRANSFER*

CNES strategy in technology transfer and in application development can be explained following this scheme:

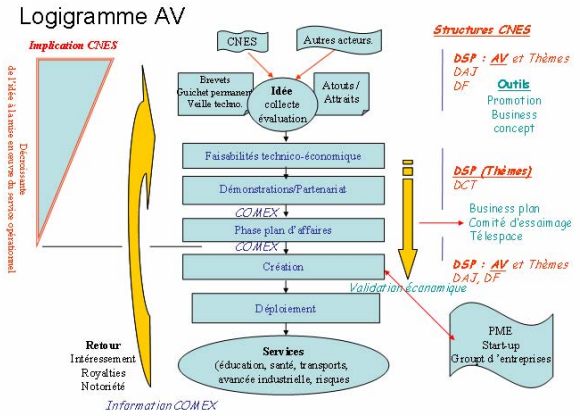

Figure 2. Technology transfert and application development strategy

The main objective is the creation of new services in the domain of health, with CNES financial support from the demonstration project until the business plan of the future service operator firm.

3. TELE-CONSULTATION

3.1 PROJECT SUPORTED

A number of space-based telemedicine networks have been set up recently to provide teleconsultations in dermatology, emergencies and tropical medicine. In French Guyana, a pilot experiment was conducted from end 2001 to the spring of 2002, with funding from the Ministry of Health, by Andrée Rosemont hospital in Cayenne and CNES, in close cooperation with the MEDES space clinic. Four health clinics at isolated spots in the Amazon jungle were supplied with telemedicine kits to be able to send imagery and digitized tests via satellite for dermatology, cardiology and tropical medicine. The results were so encouraging that the four sites have been made permanent, and the Ministry of Health and the European Regional Development Fund are providing funding to equip all of the 21 clinics linked to Cayenne hospital with a telemedicine kit.

Looking ahead, other telemedicine projects are in preparation. For example, the Ministry of Health has commissioned a study to deploy telemedicine systems in all of France's overseas territories and dependencies (French Polynesia, New Caledonia, etc.) and those countries for whose health policy it is responsible (Madagascar, Seychelles, Rodrigue, etc.).

Projects concerning medical emergencies in ambulances or during natural and man-made disasters are also being considered as part of ESA's DELTASS initiative (Disaster Emergency Logistic Telemedicine Advanced Satellite System) and I-DISCARE also funded by ESA.

More recently, responding to French President, Mr.Jacques Chirac to be able to provide support in the early hours of a major catastrophe for crisis management, and under the responsibility of Mrs.Nicole Guedj, CNES, ALCATEL ALENIA SPACE, REMIFOR and French Civil Security, EMERGESAT project aims at developing a transportable device integrating communication tools (satellite communication facilities, GSM, Wifi, …), situation evaluation for risks, water needs and first help. EMERGESATconcept has been presented at Tunis World Submit for Telecommunication and Information in 2006. A prototype is tested and is about to be delivered. An operational version is awaited for early 2007.

3.2 SERVICE PROVIDERS CREATED

Major achievements in the domain of tele-consulting are:

- the tele-medecine mobile unit, commercialized by MEDESSAT,
- the creation of the service provider Telemedicine Technologies SA in 2000, a spin off ET ASSIST and Ten Telemed projects supported by EU,
- the creation of another service provider MEDESSAT, a spin-off DELTASS and I-DISCARE projects supported by ESA within the ARTES program. This new firm has been funded by CNES, ALCATEL ALENIA SPACE and MEDES, in the frame of CNES sustainable services strategy.

4. TELE-EPIDEMIOLOGY

Tele-epidemiology consists in studying human and animal epidemics, the spread of which is closely tied to environmental factors.

By combining vegetation index data from SPOT, meteorological data (winds and cloud masses) from Meteosat, and other Earth observation data from Topex/Poseidon and Envisat (wave height, ocean temperature and colour) with clinical data from humans and animals (clinical cases and serum use) and hydrology data (number and distribution of pounds, water levels in rivers and reservoirs), we can construct predictive mathematical models.

4.1 PROJRCTS SUPPORTED

Figure 3. International cooperation

We tested several years a number of such approaches:

- in Senegal, Rift Valley fever epidemics are being monitored using a predictive model based on the rate at which water holes dry out after

the rainy season observed by Earth Observation Satellite Data, which affects numbers of virus-carrying eggs; risk maps are defined and used. This epidemiologic data network is operational and is actually operated by the DIREL (Direction de l'Elevage).

- in French Guyana, a tele-epidemiology network was set up to monitor hemorrhagic dengue fever; here again, combining satellite data and epidemiological data is helping to make prevention more effective. The demonstration phase ended in 2004. The operational phase is undergoing.
- as part of the French Ministry of Research's Earth-Space Network, a pilot sentinel network has been deployed in Niger and Burkina-Faso to monitor infectious diseases whose spread is tied to environmental factors. For example, parameters coming from satellite observations such as dust clouds and wind appear to play a crucial role in triggering and spreading meningococcal meningitis. This data collecting network is operational and is actually operated by the CERMES (Centre de Recherche Médicale et Sanitaire).
- in the frame of the cooperation agreement between both Chinese and French space agencies, West Nile Virus, avian influenza and Japanese encephalitis will be monitored through BIBO (Bird Born disease) project stated end 2005.
- lastly, a French consortium is monitoring cholera epidemics around the Mediterranean basin; this project is using mathematical models to assess the risk of a resurgence of the disease, which is linked to numbers of cholera-spreading zooplankton which is quantified by data coming from satellite images of the sea (wave high, currents, colorimetry .

Tele-epidemiology prove that existing resources—satellites, medical kits, infrastructures and so forth—can be exploited to improve quality of treatment, particularly where environmental conditions are precarious, and achieve significant savings in public health costs. Ground-based data collection and transmission networks supported by satellite imagery can play a vital role in preventing the spread of diseases due to environmental factors. And epidemic monitoring networks can be a first step toward a European health early-warning system, as suggested by the European Commission and voted by the European Parliament.

4.2 SERVICE PROVIDERS CREATED

As tele-epidemiology is a relatively new domain, first results validated by users have just been obtained. For that reason, it seems too early to have service providers in the short term. But we do expect to reach such an achievement.

5. CONCLUSIONS

Since 1999, CNES in the frame of the S2E consortium (Space Survey for Epidemies, gathering CNES, MEDIAS, MEDES, CLS, Institut Pasteur and Ecole Vétérinaire de Lyon) has been working with health professionals to consider how space-based systems could improve health care, notably through telemedicine applications.

Supporting a sustainable services approach, CNES strategy has obtained first tangible results with the creation of new services providers in the domain of tele-consultation.

This approach gives encouraging results in the domain of tele-epidemiology with first products dedicated to professional users in the domain.

These products integrated in an information system for epidemiological data collecting network can be part of an early warning system, providing capable tools for epidemic monitoring as suggested by the European Commission and voted by the European Parliament.

Following its strategy for sustainable services development, CNES has supported the creation of service providers in tele-consultation, and expect such an achievement in tele-epidemiology.

6. ACCNOWLEDGEMENTS

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- Mr.Laurent Braak from MEDES

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National Control Program of Chagas Disease: Spatial Identification of Infested Houses Notified by Communities under Entomological Surveillance Using GPS Technology to Monitor and Define Areas under Risk of Reinfestation

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Chagas disease is a Public Health problem in Paraguay. It is estimated that 400,000 individuals (6% of total population) are infected with the parasite Trypanosoma cruzi, transmitted by triatomines bugs that are mainly present in rural areas. 344,048 dwellings in 3,653 localities distributed in 12 endemic departments were entomologically evaluated and sprayed in the last 5 years, and horizontal surveillance systems with community participation were implemented for the sustainability of the vector control activities. Since 2003, Global Positioning System (GPS) is used by the Paraguayan National Control Program of Chagas Disease, and entomological database historically recorded was geo-referenced. Up to date, geographical localization and spatial distribution of infested houses in areas under entomological surveillance can be visualized in maps. The precise location of these houses, occurrence of re infestations and the risk of infestation of neighboring houses can be identified. The National Program used GPS in a retrospective analysis to evaluate areas previously sprayed. Newly infested dwellings detected in areas under surveillance were proven to be operational field failures performed in the past during vector control activities. Another advantage observed with using GPS technology is the better planning of operational strategies for vector control, such as saving cost for human effort, number of personnel involved, time and transportation in hyper-endemic areas where very low density of dwellings are presented (60% of the Paraguayan territory has 28,500 houses in 246,925 square kilometers). This work was supported by UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR), and the Government of Canada through the Canadian International Development Agency (CIDA) within the project (Prevention and Control of Priority Communicable Diseases in South America).

Keywords: Trypanosoma cruzi, Triatoma infestans, Global Positioning System, Chagas´disease.

I. INTRODUCTION

For items not addressed in these instructions, please refer to the Educational Coordinator. Chagas´ disease, which is responsible for considerable morbidity and mortality in Latin America, is caused by a protozoan parasite, Trypanosoma cruzi. The potential T. cruzi vectors comprises more than 130 species of triatomine bugs from the family Reduviidae, but five of them have special epidemiological significance: Triatoma infestans, T. brasiliensis, T. dimidiata, Rhodnius prolixus, and Panstrongylus megistus. These species are characteristic of open environments of Central and South America, either natural areas (savannas and grasslands, grassland-woodland mosaics, dry forest, and the desert and semi desert Andean valleys) or man-made ecotopos. Triatomines that colonize houses permanently and are markedly anthropophilic are considered to be of primary epidemiological importance. The distribution is typically focal, and population density is conditioned by availability of food. The dispersion can be passive or active, passive depends on human behavior, e.g. passive transport on clothes, vehicles, or the collection of wood in the peridomestic environment. Active dispersion by flight is associated with the need for feeding and through the dispersion of adult vectors. The flight distance of a vector does not exceed 200 meters.

In July 1991, the Ministers of Health of Argentina, Bolivia, Brazil, Chile, Paraguay and Uruguay, decided to implement a strategy aimed at the elimination of Chagas disease by interruption of vectorial transmission and the systematic screening of blood donors. One of the objectives included the elimination of T. infestans from both dwellings and the peridomiciliary environment in endemic areas. The definition

adopted for the elimination of T. infestans was the ¨lack of detection of any specimen of T. infestans in the intradomiciles for a minimum period of three years in an area with entomological surveillance established¨.

In Paraguay the main vector is T. infestans, and Chagas disease is considered to be endemic in all rural areas.

In 1999, Paraguay strengthened the national vector-control program with remarkable success. In 12 endemic departments an operational methodology was performed; 344,048 dwellings distributed in 3,653 localities were evaluated, with spatial contiguity and temporal continuity. The organization model was as ¨national campaigns¨, with technical decisions made at the central level and the operations executed by specialized program staff, this ensured properly coordinated operations and the same methods were used by all. Entomological research in each dwelling, before and after spraying interventions, was performed. The information data obtained at local level was registered, with special interest in entomological indicators needed for the certification of the elimination of T. infestans: number and stage of species present, as well as their dispersion and infestation rates. Intradomiciliary and peridomiciliary areas, in two successive cycles per infested houses at 6-monthly intervals were sprayed with residual insecticide. These interventions were performed by SENEPA staff, the national institution involved in vectors control activities at the Ministry of Health. Surveillance to ensure the early detection of reinfestation was undertaken after the two initial attack cycles with insecticide, and was implemented with community participation combined with active search by program staff. Natural community leaders and school children from rural endemic areas play a special role in the entomological surveillance system implemented by the national program since 2002.

In this study, epidemiological, digital and Global Positioning System (GPS) data have been incorporated into GIS data-bases to better understand the spatial distribution of entomological findings in infested dwellings detected during control and surveillance activities of the National Program of Chagas disease in Paraguay.

II. MATERIALS AND METHODS

The geographic position, latitude and longitude information, of 2,650 triatomine- infested dwellings present in two endemic departments was recorded with a III Plus GPS receiver manufactured by Garmin (Garmin International, Inc., Olathe, KS). The entomological database is systematically recorded by the National Program since 1999 up to date; each infested dwelling detected during control and surveillance activities was visited by a program staff who registered latitude and longitude with the GPS receiver right in front of each house.

ArcView 3.2, created by the ESRI corporation, was used as GIS software. The entomological information recorded such as, year of detection, bug species and stage, localization (inside the house – domiciliated or in the peridomicilliar, have been used as thematic raster base map for displaying infestation and colonization rates, dispersion index, by villages, districts and departments. These information registered at local level are updated on a routine basis.

Departmental, districts and villages border boundary data were obtained with high resolution images (Digital Orthophoto Quarter Quadrangles, or DOQQs) for the entire country.

III. RESULTS AND DISCUSSION

Geographical Information System (GIS) was used as an analysis tool to map the distribution of villages with different infestation rates in two endemic departments named Paraguari and Cordillera. Villages demanding focal or total spraying interventions due to the infestation rate detected during vector-control activities were analyzed. The pattern obtained in maps with the incorporation of this information, especially in those areas that demanded wide spraying interventions, gave us a better understanding of the situation at departmental level. We visualized contiguity areas under high risk of reinfestation and conducted special interventions such as active search by program staff and the incorporation of more effectors for surveillance in those villages.

Global Positioning System (GPS) receivers were incorporated to visualize the precise geographical distribution of infested dwellings in the villages and districts. The spatial information combined with the entomological data achieved in GIS, gave us the possibility to evaluate the dispersion of triatomine species, areas of colonization, the distribution of new infested dwellings with temporal information and areas with domiciliary T. infestans-infested-dwellings. Databases associated with GIS included name of village, information about infested dwellings: species present, colonization and place of detection, intra and peridomiciliar, year of detection, effectors at the community level that made the notification, natural infection of bugs, etc.

GIS/GPS helped us to discover and visualize new data patterns and relationships at local level that would have otherwise remained unnoticed such as infested houses notified during surveillance in the last three years, aggregated in focalized areas. These special patterns of infested houses present in the border line of more than two contiguous villages, as conglomerates, represent an infestation rate higher than 5%, demanding an insecticide intervention in all infested and neighboring dwellings. Up to date, this type of spraying intervention was executed based on village rate infestation. If those two or three contiguous villages did not have an infestation rate over 5%, each village would have been just focally sprayed (infested dwellings and those present at 200 meters of distance). Valuable operational information in this area is the total number of not infested dwellings present, meaning the number of neighboring houses under risk of infestation. With all these information, it is possible to design strategic operational field work with reduce cost of intervention thus maximizing the potential and outcomes of available control resources (human, financial and technical). The data is available because the geographic position of 1,200,000 Paraguayan dwellings with GIS/GPS was recorded in 2002 during the National Census performed by the DGEEC (General Direction of Statistics, Inquiries and Census). The

infestation rate visualized with GIS as village polygons, did not give us the same spatial information necessary for this type of special intervention.

The distribution of infested dwellings notified during surveillance by natural community leaders, householders and school children in the last three years, is shown at local level in maps, and we can still observe a high dispersion of T. infestans at department level.

In 2003, we designed an operational strategy for vector control, in a hyper-endemic area where very low density of dwellings are present (Occidental Region, 60% of the Paraguayan territory has 28,500 houses in 246,925 square kilometers). The information obtained from the DGEEC with the spatial distribution of dwellings and villages using GIS/GPS technology allowed us to make a cost-effective intervention with more efficient and effective resource utilisation, such as number of personnel to be involved, time needed and cost of transportation. The map developed using GIS technology, compared with tables and charts, proved to be an extremely effective tool to show our strategy to the community decision makers of Chaco Central. It was possible to visualize and understand our intervention strategy to solve a public health problem in their well-known territory.

These GIS relational databases are being used as a powerful tool in order to monitor the status control of infested areas and to evaluate the impact of control and surveillance effort to eliminate domiciliary T. infestans.

Historically, maps describing the spatial distribution of vectors and other diseases have been limited to hand-drawn representations on pre-existing maps. GIS, with new advances in image processing and GPS to geo-reference databases, provides a new and powerful tool to efficiently store, retrieve and interpret entomological databases for epidemiology, ecology and control studies in Chagas disease.The entomological data information recorded during operational control and surveillance activities, combined with the spatial model capabilities of geographic information systems, proved to be useful for characterizing and monitoring the spatial and temporal patterns of those villages where infested houses are detected. With this information, a complete picture of the entomological situation is viewed up date.

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Development of Portable Telemedicine Station: A design aproach

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Abstract- Portable telemedicine devices developed last years focus their functionality in offering solution to a specific problem. The approach of our development is centered in offering a device that allows the user to select its configuration in function of the demands, single changing a device of the type pen drive. The results obtained in our design validate the concept of portability and wished functionality, allowing us now to focus in the development of specific applications

I. INTRODUCTION

In our works of field in the area of the telemedicine, we have found that the developments available focus in offering connectivity by different communication channels to conventional diagnostics medical equipment.

Equipment for the measurement of ECG, EEG, pulse oximeter´s, patients monitoring, etc. are available integrated in a card to connect a computer or could be commercial devices with interface of connection for remote access.

Our concept supposes that a portable unit based on computer motherboard could be developed, with physiological programmable data acquisition devices of way so that with few peripheral, a device of flexible configuration can be obtained. In order to begin the work, we decided to try the implementation of 3 functionalities with the common hardware:

1. Mobile Intensive Care Unit
2. Clinical Lab Station
3. Central Management Telemedicine Station

In this paper, we try to discuss our goals and disadvantages, in order to do an evaluation of the functionalities obtained.

II. GENERAL PROJECT

The station characteristics will be:

- One hardware platform for the requirements of the three suggested applications
- Booting configurable device
- Patient interface hardware remotely configurable
- "Real" portability: less possible weight and maximum energy support.

In order to do a prototype, we use an Intel chipset motherboard with a 1 GB pen-drive booting device, 512 MB RAM, TFT 17" monitor and USB Bluetooth communication system. The energy necessary for the station was provided for a PC power supply modified to support a 24 volt battery input. All the components placed in an aluminum case.

The Bluetooth enable the system to connect to patient interface in the ICU mode of operation, and to maintain wireless communications in another two settings.

The station will be provided with the following hardware in each configuration:

Mobile Intensive Care Unit:

- Booting device
- Bluetooth communication
- Patient modules (developed with a DSP chip and a Bluetooth interface)

Clinical Lab Station

- Booting device
- USB analytical modules
- Necessary chemical stuff
- Calibration procedures

Central Management Telemedicine Station

- Booting device
- USB communication system
- VoIP communication system (micro and speakers)
- Radio interface
- GPS
- Videoconference system

III. Preliminary Results

Mobile Intensive Care Unit:

The m-ICU can be divided in two parts: the central unit and the system of data acquisition of the patient. The central unit could provide all the necessary to perform an ICU monitor system, with programmable alarms, pager message option, etc.

The patient side constituted by a measurement system and 11 channels digital analogical conversion of physiological variables and a Bluetooth communication system. In the prototype 4 measures were implemented: ECG, Temperature, FR and FC.

The central unit and each patient interface have a wireless Bluetooth link, we perform the analysis simulating only 3 patients in a room.

The system start and then try to link and identified each patient monitor. After this operation, measurements taken and processed by the devices, was displayed in each patient window in the central unit. No interferences or any other success was detected in a room with fluorescent lamp, two AC motors and a air conditioning system working at the same time.

Clinical Lab Station

With the same hardware mentioned before, we have programmed a basic center of clinical analysis. For it, we used a coulter blood analyzer with measurement of hemoglobine concentration, a PH-meter (temperature compensated) and a 340 nm absorption meter. The devices were connected to a microprocessor, with an USB interface.

The microprocessor captures the data output of each system, conform a first processing and then send it to the USB port, that is connected to the main computer.

With this structure, we can add a wide variety of analysis interfaces, to perform so many determinations of biochemical parameters as we consider necessary.

Practical results show us that we have some software incidences in the microprocessor, that will be corrected in the future.

Central Management Telemedicine Station

This application was developed thinking about offering a solution of close support in telemedicine in a catastrophe zone. It will provide all the necessary to establish a wide variety of communication link between the remote position and a central hospital, for example. Modules mentioned before, in the other systems configurations, could be programmed and connected using the USB interface allowing us to be able to send data of patients through some of communication media that the station has in this configuration.

We are trying to do an integration of all data in order to improve the performance of the final setup.

IV. Conclusions

With the same hardware core and a system configuration installed in a USB pen-drive, the portable medicine station was demonstrated a flexible configuration and it allowed us to validate the design concepts. Numerical results and validation data are being obtained at the time of writing this article. We wished to interchange opinions about the design aspect in our work, to be able to optimize the performance and functionality of the station.

Telemedicine Applications in Mobile Surgery

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BACKGROUND: Mobile Surgery is an innovative way to deliver high quality surgical services to underserved regions of Ecuador. The system has proven to be safe, with a low complication rate, and cost-effective. The sizeable geographic area it covers as well as the remote and rural environment create a challenge for pre-operative and post-operative care. The use of telemedicine applications however may eliminate the long distance intricacies in patient selection, on-site organization, and patient follow-up, and intra-operative consultation if necessary.

METHODS: Several systems of establishing telemedicine connectivity between 2 points have been completed. These include plain old telephone lines, dial-up Internet connections for real-time consultation and store-and-forward images, ISDN and satellite connectivity. Two laptop computers and a desktop have been utilized as hardware, and occasionally a RDTU (rapidly deployable telemedicine unit).

RESULTS: In the pre-operative phase we have applied telemedicine for consultation and patient selection. It has decreased the pre-operative time during the remote visit, thus translating into more operating room time. During the intra-operative period we have conducted several projects: Teleanesthesia: to monitor events from a remote location, including the intubation phase, and vital signs throughout the case. Telementoring: where a surgical resident safely complete a laparoscopic cholecystectomy in the jungle of Ecuador under the guidance of a laparoscopic surgeon in the U.S. Telepresence: consultants at a remote location identified anatomical landmarks and participated in surgical decisions in real time. Teleconsultation: in a pediatric urological case providing a specific level of expertise. Finally, in the post-operative period to conduct patient follow-ups at a distance, assessing the surgical wounds for signs of potential complications.

CONCLUSIONS: Telemedicine has rendered our program more effective in patient selection; anticipation of medical supplies needed for surgical missions, and decreasing time spent in pre-operative planning at remote locations. Telemedicine also allows us to maintain reliable postoperative surveillance of our patients until their complete recovery and convalescence, overcoming one of the main constraints of intermittent mobile surgery services. It is also an invaluable aid in areas of our country, and perhaps remote areas around the globe where patients have limited access to an experienced surgical team.

KEY WORDS: Mobile Surgery, Telemedicine, Telepresence, and Telementoring.

BACKGROUND

Since 1994 the CINTERANDES Foundation has been providing intermittent surgical services to remote areas of Ecuador by means of an innovative Mobile Surgery Unit, which can travel through the rough Andean terrain to reach underserved regions and deliver high quality surgical care [1-3]. (See figure 1 and table I). The results of our experience have demonstrated the system to be safe and cost-effective, with low complication rates [4,5] (see Table II), due to strict adherence of established protocols [6].

The sizeable geographic area of coverage and remoteness of some of the rural communities creates a challenge for assessing patients in the pre-operative period, as does patient follow-up in the post-operative period. The introduction of telemedicine applications into our program however, may eliminate the long distance intricacies of operability and aid us in the patient selection process, on-site organization and resource utilization. Intra-operatively it could be used for consultation if necessary, and to facilitate patient follow-up by our surgical team post-operatively.

Figure 1. Mobile Surgical Unit in rural Andean Community

TABLE I.

Total Number of cases in Mobile Surgical Program.

SPECIALTIES	NUMBER OF CASES
General Surgery	2411
Urology	1444
Gynecology	767
Plastic Surgery	359
Ophthalmology	95
ENT	6
TOTAL	5082

TABLE II.
Surgical Complications in Mobile Surgery

COMPLICATIONS	NUMBER (PERCENTAGE)
Deaths	0 (0%)
Cardiac arrest	2 (0.04%)
Pulmonary embolism	1 (0.02%)
Colonic injury	1 (0.02%)
Bladder perforation	1 (0.02%)
Bleeding	
Slight	15 (0.30%)
Moderate	27 (0.54%)
Severe	2 (0.04%)
Infection Rate	
Clean cases	24 (0.49%)
Clean contaminated cases	124 (2.48%)

METHODS

Several systems for establishing telemedicine connectivity between 2 points have been employed. Beginning with point-to-point plain old telephone lines (POTS) connection, or dial-up Internet connections. In other instances, ISDN and satellite phone connectivity was utilized. Both real time videoconference and/or store-and-forward techniques for telemedicine were used for pre-operative evaluation, surgery, and post-operative follow-ups.

The average distance between remote sites and the surgical center was 200 miles; in instances more than two points in different countries were connected at the same time performing real time video conference or sharing data. Fix telemedicine stations were established in some remote locations for permanent telemedicine consultation; otherwise telemedicine advance teams connected the remote/rural sites with the surgical centers. The fix telemedicine stations were equipped with a desktop Pentium 4, 2.4 GHz, 512 MB RAM, videoconference camera and digital camera for still pictures. The Telemedicine remote teams were equipped with a Pentium III 800mHz PC laptop computer, videoconference camera and digital camera for still pictures; each computer had integrated audio/video software for videoconferencing and an electronic medical record (EMR) data sheet developed specifically for the projects. Occasionally a RDTU (rapidly deployable telemedicine unit) was used.

RESULTS

Since 1997 we have conducted several telemedicine projects, initially with the support and collaboration of the Department of Surgery of Yale University, New Haven, Connecticut; and lately with MITAC (Medical Informatics and Technology Applications Consortium), Department of Surgery, Virginia Commonwealth University, Richmond, Virginia. These projects have been conducted at different stages of our surgical relief missions:

Pre-operative Phase

We conducted the first real time patient interview from our headquarters in Cuenca to the Amazonian town of Sucua. We established patient physician relationship, made an accurate diagnosis, determined the treatment plan and gained the patient trust via telemedicine. Subsequently, on a case study previously reported, there was 100% concordance between an on-site and the telemedicine diagnosis by surgeons in 8 patients [7]. In a larger series we recently reported a 77% agreement in pre-operative diagnosis between the on-site and remote surgeon [8]. Radiographs and ecosonograms have also been made available from the remote site via store and forward files for pre-operative assessment [9].

Intra-operative Phase

In this phase we have also conducted several projects:

• *Teleanesthesia:* we used telemedicine to monitor anesthetic events from a remote location, including the endotracheal intubation as well as monitoring vital signs and events throughout while the patient was under anesthesia [10].

• *Telementoring:* we reported the first international telementoring session from Yale University in New Haven, Connecticut to Sucua, in the jungle of Ecuador, where a surgical resident safely completed a laparoscopic cholecystectomy under the tutelage of a laparoscopic surgeon [11].

• *Telepresence:* we have validated real time agreement with the consultants at a remote location regarding identification of anatomical landmarks and surgical decisions at critical steps of surgical procedures [12].

• *Teleconsultation:* with the use of telemedicine we have been able to obtain highly specialized consultation from abroad for pediatric urological surgical pathology in which a specific level of expertise was required.

Post-operative Phase

Finally, in the post-operative period we have been able to conduct patient follow-ups at a distance. One of our studies achieved a concordance of 94-100% between the surgeon and a primary care physician regarding wound healing, presence of infection or complications [7]. A recent report of 37 post-operative evaluations showed 97% agreement between the on-site and remote surgeon [8]. (See figure 2).

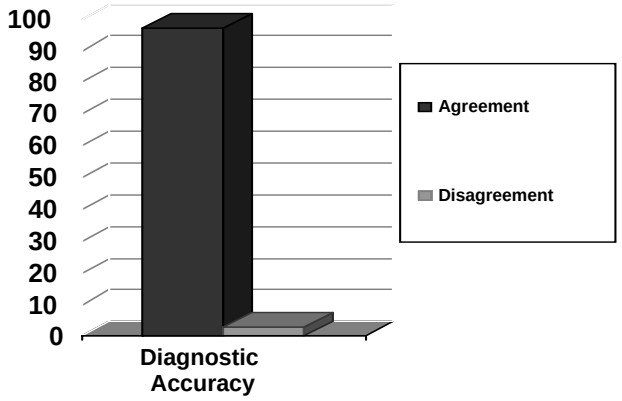

Figure 2. Percentage of Post-operative diagnostic accuracy via telemedicine

DISCUSSION

The advantage that Telemedicine grants is an excellent complement to our Mobile Surgery Program, as this technology is applied to an efficient, well-designed and established surgical relief effort, rather than developing a particular program to be compatible with the technological application (figure 3).

There were several difficulties encountered throughout our projects; briefly they include restriction bandwidth capabilities in some instances, disconnections of the link, and photographic quality in other cases. However, these can be improved and the overall impact in the results was not significant. Satellite connectivity may become more accessible and cost-effective in the future expanding the possibilities of Telemedicine.

Applying telemedicine in the pre-operative consultation has made us more effective in patient selection, organizing the operating schedule in advance, and foreseeing medical supplies for adequate resource utilization. It has also enable us to save precious time during our remote visits, which in turn translates into more operating room time. Overall, the surgical team feels much more comfortable being acquainted with the patients and their specific needs in advance. We are also conducting a validation study to determine patient and physician satisfaction with the use of this technology.

During the surgical missions per se, it is possible to have real time consultation assistance by experts and specialized centers if need be. At the same time it can be used as an educational tool while in the operating room to overcome space limitation. One of the difficulties of intermittent surgical services constitutes patient follow-up by the same operative team. With telemedicine it is possible to conduct patient follow-ups at a distance, assessing the surgical wounds for signs of potential complications.

Telemedicine has been an invaluable aid for our Mobile Surgical Program in remote areas of our country where conditions can be extreme [13]; perhaps this technology could be implemented into existing healthcare programs around the world where there is limited access to medical expertise. This can help to overcome the isolation confronted by first line medical personnel in underserved areas.

Figure 3. Telemedicine for pre-operative phase.

CONCLUSIONS

Telemedicine has rendered our program more effective in patient selection, anticipation of medical supplies needed for surgical missions, and decreasing time spent in pre-operative planning at remote locations. Telemedicine has also shown to be an invaluable aid in remote areas of our country where limited access to medical expertise is available.

Telemedicine allows us to maintain reliable postoperative surveillance of our patients until their complete recovery and convalescence, overcoming one of the main constraints of intermittent mobile surgery services. When Telemedicine applications are integrated to well-designed healthcare programs in remote areas they can improve patient care.

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River Health: Description of an Integral Healthcare Program in a Remote River Basin of Ecuador

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Abstract- The province of Morona-Santiago is probably the most isolated in Ecuador; furthermore, its Eastern zone has practically no roads, and the only means of access is by small aircraft to rudimentary airports in the jungle. The villages are linked through a rich network of rivers. The health situation is appalling and healthcare is precarious. Malnutrition, parasitism, tuberculosis, malaria, hepatitis and other diseases are prevalent. Therefore, we believe it is necessary to organize a fluvial healthcare unit in coordination with fixed health posts as a system to deliver health to the area. In April 2001 navigation of the main river, Morona and its effluents by motor powered canoe was completed in an attempt to chart the river path by GPS, and to determine adequacy of depth and width throughout the watercourse. Agreements were signed between the central and local governments, private companies and NGO's for the financing, construction, equipment, administration and execution of the project. We have been offered to utilize satellite technology to determine river conditions to help in assessing operability and safety of the fluvial unit. A multidisciplinary team in conjunction with the natives will elaborate a model of development for the area with minimal infringement of the fragile Amazonian ecosystem. The integral health program will include: health information gathering, immunization, growth and development, prevalent diseases of infancy and school aged children, sexual health and reproduction, geriatrics, oral and mental health, education for basic sanitation, and compilation of traditional knowledge regarding medicinal plants and their application. We will also have intermittent surgical brigades 3-4 times a year. To facilitate the implementation of the program we will make use of Telemedicine for consultation and support from the CINTERANDES foundation headquarters in Cuenca and MITAC in Richmond, Virginia. The results of our efforts so far have accomplished the foundation on which the program will build on. We produced an accurate map of the river conditions in conjunction with the location of the villages. The extension of traversable river is approximate 100 Kms, with an estimated population of 5,000-10,000. The fluvial unit was built in Ecuador and contains an operating room, recovery room, a consultations office and living quarters. It is capable of negotiating the charted channels. We anticipate the project will be activated in mid 2006 and its results will be reported thereafter.

KEY WORDS: River Health, Healthcare, Integral Health, and Telemedicine.

INTRODUCTION

Of the 22 provinces that make up Ecuador, Morona-Santiago located in the nation's southeastern region is probably the most isolated in Ecuador; furthermore, the area east of the Cutucú Andean mountain range has practically no roads, and the only means of access is by small aircrafts which have to land in rudimentary airports in small clearings in the dense jungle. In the remote river basin of the Morona River numerous small primitive villages are linked through a rich network of waterways.

The health situation in these rural communities is appalling and healthcare is precarious at best. National health statistics indicate that malaria, malnutrition, parasitism, tuberculosis, hepatitis and other diseases are prevalent. However a database that reflects the true state of health and necessities of the population in this region is deficient. Due to its remoteness, development of the area has been relegated. Therefore, we believe it is necessary to organize a healthcare and human development program that will have a fluvial unit in coordination with fixed health posts located throughout the river basin as a system to assess and deliver healthcare to the area.

Project Conception

The CINTERANDES Foundation has been providing surgical services to many remote areas in Ecuador since 1994

by means of a Mobile Surgical Unit [1]. We have excellent outcomes, with low complication rates [2] (see table I), and in a cost-effective manner [3]. An advantage of this model is that patients are cared for in their own environment with the active participation of the community. Our work captured the attention of a missionary who lived in the province of Morona Santiago and knew in detail the living conditions and necessities of the villagers.

TABLE I.
Surgical Complications in Mobile Surgery

COMPLICATIONS	NUMBER (PERCENTAGE)
Deaths	0 (0%)
Cardiac arrest	2 (0.04%)
Pulmonary embolism	1 (0.02%)
Colonic injury	1 (0.02%)
Bladder perforation	1 (0.02%)
Bleeding	
Slight	15 (0.30%)
Moderate	27 (0.54%)
Severe	2 (0.04%)
Infection Rate	
Clean cases	24 (0.49%)
Clean contaminated cases	124 (2.48%)

Initial Steps

In April 2001 a team of the CINTERANDES Foundation and MITAC traveled to this remote area and navigated a section of the Morona River and its tributaries by means of motor powered canoes. Utilizing a GPS unit the watercourse was charted, and determination of the adequacy of depth and width throughout the river was determined. The extension of traversable river is approximate 100 Kms, with an estimated population of approximately 10,000. After determining the negotiability of the rivers and plotting village location in our river chart we developed a proposal that was reviewed and approved by the Ministry of Health.

For a healthcare system to work in this environment and be sustainable for the foreseeable future, involvement of beneficiaries, central and local governments, private companies and NGO's had to be integrated. An agreement was signed between the different parties for the financing, construction, equipment, administration and execution of the project [4]. The following institutions are participants in the project: the Ministry of Public Health, MODERSA, and the Healthcare Department of Morona Santiago, PETROECUADOR, the Provincial Council of Morona-Santiago, ECORAE, and the CINTERANDES Foundation which will be in charge of the supervision and execution of the project, as well as to carry out the surgical brigades. MITAC will provide support for the telemedicine component.

The Fluvial Unit

The Fluvial Unit was built in Durán, Ecuador; it is 18 meters in length, 4.5 meters wide, 2.1 meters tall, with 0.4 meters of draught. It contains an operating room, recovery room, a consultations office and living quarters. The unit was delivered by land to Puerto Morona, a village that has access by a dirt road where it will be fitted with the necessary equipment.

Integral Healthcare Program Design

The specific objectives of the Integral Healthcare Program include:

1) Health information gathering. 2) Complete primary care services for the area of Morona River basin and its main tributaries. 3) Perform intermittent surgical brigades. 4) Conduct a study of the main health problems of the area. 5) Define in conjunction with the population and a multidisciplinary team a model of human development in harmony with the Amazonian ecosystem.

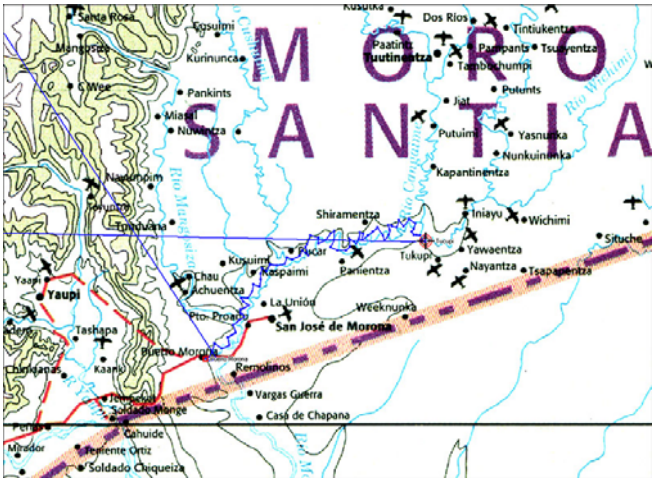

Figure 2. "TSUNKI NUA" Fluvial Unit.

The Primary health team will be composed of 2 physicians, a nurse and a dentist. This health team will navigate the Morona River and tributaries 3 weeks of each month depending on river conditions. The integral health program will include: immunization, growth and development, prevalent diseases of infancy and school aged children, sexual health and reproduction, geriatrics and rehabilitation services, oral and mental health, education for basic sanitation, and compilation of traditional knowledge regarding medicinal plants and their applications (see table II).

TABLE II.
Integral Healthcare Program

COMPONENTES OF INTEGRAL HEALTHCARE PROGRAM
Information gathering
Immunization
Growth and development
Prevalent diseases
Sexual health & reproduction
Geriatrics
Rehabilitation services
Oral health
Mental health
Violence, alcohol & drug prevention
Education in sanitation
Traditional knowledge compilation
Surgical missions

Surgical Component

It has been our experience that owing to surgery's dramatic effects and our positive outcomes, it has allow us to gain trust and credibility, and consequently facilitate the implementation of other healthcare programs that have greater impact in those communities. Therefore, we will carry out intermittent surgical brigades 3-4 times a year, and at the same time we will provide consultation by university physicians and will assist in the data collection and analysis.

Satellite Technology

Although the Morona River confers an effective passageway into these remote villages, the navigational hazards associated with changes in water levels may constitute an inconvenience. We have been offered to utilize experimental satellite technology for hydrologic forecasting to determine river conditions, and aid in the assessment of operability and safety of the fluvial unit. Updated forecasts of river flow conditions could be made available via telecommunications to the CINTERANDES Foundation.

To facilitate the implementation of the program we will make use of Telemedicine for consultation and support from the CINTERANDES Foundation headquarters in Cuenca and MITAC in Richmond, Virginia. From previous experience with telemedicine we have demonstrated its capabilities in the pre-operative evaluation, and in post-operative patient follow-up as an invaluable tool that can breach the distance of remote and isolated areas [5,6].

CONCLUSIONS

The results of our initial efforts have accomplished the foundation on which the program will build on. It is feasible to navigate the Morona River with a fluvial unit that can carry out an Integral Healthcare Program in coordination with fixed healthcare posts.

Joint efforts of the public and private sector have conceived a comprehensive healthcare program that could be exploited as a model for future projects in similar conditions.

Satellite technology can give support in hydrologic forecasting to help determine navigability of the fluvial unit. Telemedicine can be effectively used to provide support and improve patient care. We expect the program to be activated in mid 2006.

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National Tele-Health Program in Mexico

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Introduction

Mexico has great extensions of land and its population has enormous socio-economical disparities. Interesting mortality and morbidity patterns are present, which combine diseases characteristic of developed countries, with infectious diseases and others related to poverty. Both groups of diseases require urgent participation of the health authorities.

As in many developing countries in the world, people that live in remote rural areas have problems to access to medical services. Mainly, these problems are due to geographic aspects, inaccessibility caused by inadequate roads and transportation infrastructure. They also include economic, labor and cultural aspects (1).

According to the Mexican Political Constitution, every citizen has the right to receive health care. Nevertheless, based on recent statistics published by the National Institute of Statistics, Geography and Informatics (INEGI), only 60.1 percent of the population has access to health services. These services are offered by social security institutions, such as the Mexican Institute of Social Security (IMSS), Institute of Security and Social Services for State Employees (ISSSTE), the Mexican Petrol Company PEMEX, the Marine and Defense Ministries (Secretaria de Marina y de la Defensa Nacional). The other 40.9 percent of the Mexican population lacks of social security services, including health attention. The Mexican Ministry of Health must provide health care to this open sector of the population.

The Mexican government has detected as a priority of the Ministry of Health, the necessity to increase the accessibility to both, human and physical health resources in our country. In general there is a relative lack of hospital beds, particularly for the high specialty medical attention. There also exist an innappropriate distribution of health human resources, existing urban areas with excess of health personnel and rural areas with a historic scarcity.

Within this context, it was planned in Mexico one of the most ambitious programs of public health, the National Program of Health 2001-2006. In 2000 the government also developed the National System e-Mexico, and one of its components, the Program of Action and e-health (2). The principal objectives of both programs, include the necessity to improve the health of the population, extend the coverage and to improve the services of health. Two of the main priorities are the inhabitants of localities with high alienation levels, and the use of technologies of information and telecommunications (TIC's), to supply medical attention (3).

The restricted telemedicine activities performed in Mexico, mainly support medical education. A few telemedicine activities have been developed as pilot programs. Since 1995 the ISSSTE, which attends 10.2 percent of the mexican population, carries out its own Telehealth National Program, providing service only to the government employees sector. It is important to mention the priority of this program because it is the first telehealth program, with satisfactory development in a government institution in Mexico (4, 5).

The proposal of a National Telehealth Program in this *scenario*, represents a magnificent strategy. The aim of this study is to analyze operating aspects of public health institutions that support the necessity of improving telemedicine and telehealth activities, within a National Telehealth Program. This National Program will provide integral health care, including prevention, diagnostic, treatment and rehabilitation activities, of the three levels of health attention.

Methods

Some characteristics of the application of primary, secondary and terciary levels of medical attention are analyzed, in order to propose a National Telehealth Program. This program should include all the initiatives and telehealth actions comprised in any level of medical attention.

It must be emphasized that this model is threefold based: the first level model is based in a study realized in a rural, indigenous area located in the northern Sierra of Puebla, and is devoted to open population. The second level considers actions already realized by the ISSSTE, within its National Telehealth Program for employees of government, during ten years of operation. The terciary level model is based in a study conducted at one of the National Institutes of Health.

The rural telemedicine in Mexico, must concentrate on populations which for different reasons, have remained behind in the sanitary assistance. This situation is reflected principally in communities with scarcity of services and persistence of problems proper of low development zones. It is important to mention also, that the majority of these communities, are integrated by different indigenous groups. In Mexico there exist 21 indigenous groups and approximately 69 variants of languages. This situation is translated in difficulties to complete the actions proposed by public health programs (6).

An epidemiologic study of the zone was realized, in order to identify the principal causes of morbidity and mortality. The chosen places were analyzed by the following criteria: cost / opportunity, cost / benefit and cost / efficiency, to find out the lineaments that give certainty for the application of the model of rural health units and their connection to the first level of attention.

Regarding to the Terciary Health Care centers, for the attention of patients who do not have other social security service, the Health Ministry relies on the Institutes of National Health. It is important to point out that twelve of the thirteen National Health Institutes are located in Mexico City. This situation *per se,* establishes a critic geographic isolation for many of the states of the Mexican Republic, in terms of accessibility to this level of health care, for the open population previously mentioned.

In recent years, the statistics show a magnified demand of the medical services provided by the National Health Institutes. In particular, a documental, retrospective and descriptive study conducted in the National Institute of Medical Sciences and Nutrition "Salvador Zubirán" (INN) (7), one of the most recognized medical institutions in Mexico, analyses different efficiency, efficacy and patient related indicators, registered in a seven year period studied (1997-2003).

1. Proposal: NATIONAL TELE-HEALTH PROGRAM IN MEXICO:

1.1 Application of The E-Rural Health Program (Pilot Stage) In The Northern Sierra of Puebla (1st Level of Attention).

The e- rural health program. This program is designed to be applied between clinics and hospitals of the primary and secondary level of attention, located in zones that present certain grade of isolation (geographically, morphologically socially and economically). It will have the peculiarity to include any institution of the health sector, regardless its social reason. This fact will facilitate the interaction between telemedicine platforms, teleeducation programs, teleadministration activities, working in open Internet platforms (6)

e-Health Rural Project

The pilot project was applied in rural communities belonging to the Northern Sierra of the State of Puebla, whose grade of alienation and isolation of highways and services represented the suitable places to apply a pilot program of rural telehealth.

Eleven platforms of e-health were used (computer, peripheral, auxiliary medical electronic team and connectivity). They were provided with Internet linkage and satellital connection VSAT, using the SOLIDARIDAD satellite (Fig. 1).

1.2 National Telehealth Program of the ISSSTE (2th and 3th level of attention)

Since 1995 (1) the ISSSTE, initiated a program that includes Telediagnosis, Televisits, Teleeducation, Teleadministration activities, from units of the secondary level of medical attention, towards units of the terciary level of attention. It has been developed in three stages, creating new remote and master points, every 3 years, which were chosen based on indicators of impact: Opportunity and Benefit.

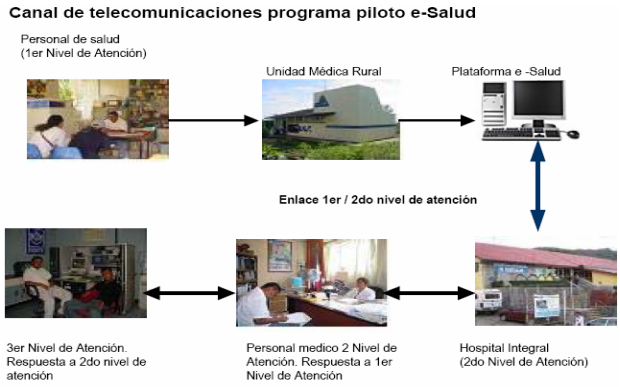

Fig. 1 Telecommunication Channel in The e-heatlh pilot program

At the present it divides the national territory in five regions, which give service to 18 units of medical attention, located in different areas of the country. Some of the results are: more than 18,000 televisits, of 54 medical specialities and subspecialities, 160 courses of medical distant education and the training of 17,500 participants in academic events (doctors, nurses and personnel of health) (8). On average, 48 percent of transfers of patients have been avoided during almost ten years, without losing the quality of the medical attention provided, to this restricted sector of the Mexican population (4).

The technology used for the linkage is the Mexican satellite Solidaridad, Band C. Considered as a priority program of health publishes, it has remained exempt from the payment of the spatial segment and has allowed to do reuse of the bearers for allocation of schedules in five regions of coverage in accordance with the places of hospitable reference.

The platform includes videoconference to 384 kbps, electronic stethoscope, electrocardiograph, camera of documents that works as negatoscope and dermatoscope of extremities, videocassette recorder VHS and DVD and monitors of plasma (4, 5).

During 2006, 11 new Units are estimated to be added to the actual network. This will allow providing medical attention to 72 percent of the population assigned to the service of the Institute, in their state of origin (Fig. 2).

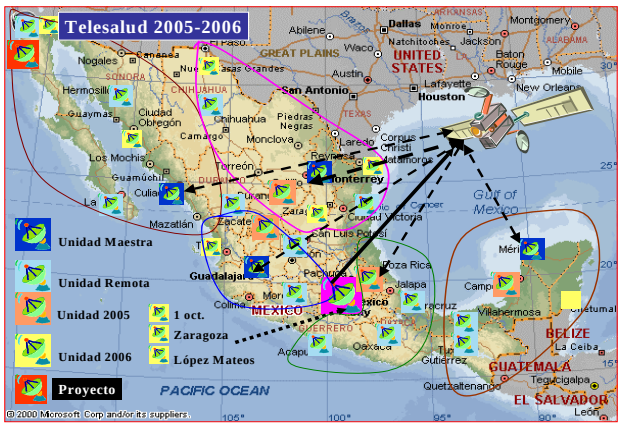

Fig. 2 National Telehealth Program in 2th to 3th level of attention

1.3 The TELEHEALTH program for National Institutes of Health (3rd level)

The study conducted in the INN, proposes to establish a telehealth net composed on a first stage, by a central station, located in the city of Mexico. This point will be in charge of the coordination with four master remote stations. Each remote station will regulate one of the four geographic regions of the country (Fig 3). They will be located in hospital units of the secondary level of health attention of the Ministry of Health,

This National Telehealth Program for the terciary level, could be also applied to the rest of National Institutes of Health, in further stages. To fulfill the terciary level necessities, satellital transmission, the rent of a bidirectional satelital channel in 800 mHz, with 512 Kbps bw and interactive videoconference platforms, are some of the technical requirements.

Fig. 3 Model of application of Telehealth in the National Health Institutes

2.- RESULTS.

The model applied in rural communities of the Northern Sierra of Puebla evidenced: dispersed populations with a deficient system of transport and communication between them, considerable distance from the communities to the biult-up areas to receive the services of medical specialized attention. Also highlighted the indigenous presence of groups like the "Náhuatl – totonaca", with a considerable social and economic isolation.

The most frequent cause of mortality are fetal deaths. Other causes could not be qualified by their incidence. This was principally owed to the wide variety of deaths and few cases that appear.

It was selected the most suitable platform to fulfill the needs perceived by the epidemiologic profile. It considered telecommunication, electronics and computation aspects. Considering the geomophologicall conditions, the satellital connection was chosen as the most effective and profitable via of communication for the application of this program.

Based on the cost/ benefit, cost/opportunity and cost/efficiency analysis, in spite of the fact that the program only avoids the transfer of a patient every two days from remote places, it will be autofinanced in a period of one year.

The application at the secondary level, has 10 years of experience and it has been dedicated to processes of medical care, education and administration. It is considered to be a mature application, which has been allowed to remain and even to expand, migrating also to new platforms in accordance to the changing technology. It demonstrated to be self financial in two years (Fig 4).

Fig 4 Telemedicine in Mexico

The model suggested for the 3rd. level in the National Institutes of Health, offers an ideal stage to lower the differences in the application of the public health. Especially it gives the opportunity to initiate the telemedicine activities right in the rural units, and it might avoid the later presentation of disease complications, with the emission of second medical opinions, expressed by medical personnel of the centers of maximum decisive power.

The study conducted in the INN propose that the four remote stations of telemedicine will be located in the states of Nuevo Leon (northeast region), Sonora (northwest), Jalisco (occident) and Oaxaca (southeast), and will attend patients from neighbor states of the republic. The decision of the location of the remote

stations, was based on two parameters: the analysis of the state of residence of the patients attended in the INN, and states with the highest rates of mortality of Mexicans without social security (Fig. 3).

The health efficiency, efficacy and patient related indicators analyzed in the INN showed sustained increases; they included: the percent of hospital occupancy, the number of hospitalizations, surgeries, laboratory and cabinet studies, total annual visits of inpatients and outpatients provided, etc. The hospitalization areas, emergency room and the outpatient visit service of the INN, are constantly saturated hospital services. Frequently, extended periods of waiting (as long as 120 or 200 days, in some cases) are required to the patients, in order to receive a date for a medical visit at this hospital.

On average, between 76.89 and 79.96 percent of the patients attended in the INN, live near the city of Mexico. Mexicans which residence is geographically distant from this point, rarely demand to receive medical attention at this institute. During 2003, 46.54 percent were patients from very low socio-economical status, who can not afford the expenses of their medical attention (7)

Conclusion

The Universal tendency and the recommendations of the group of experts in spatial matters of the UNO (2) indicate that it is necessary the use of resources for telemedicine and teleteaching from platforms of minor cost. They offer the opportunity to integrate a tidy form, which is in accordance with the capacities that every Institution or country presents. In the other had the reunion of the existing resources, selected based on valid criteria, can offer to the general population better possibilities of medical attention, eliminating the distance as one of the most significant variables that affect health actions. Using these kind of platforms, the medical attention could be provided with a permanent bond between the diverse levels of attention, maintaining a high quality service.

The developing countries need to use more platforms of conectivity to communicate Institutions. I turn, these platforms should serve to support the doctors and personnel of health located distant of reference hospitals.

A good support in the first level of attention, can make a reality the goal of the WHO, of solving 80 % of the cases that come to the familiar or general doctor, without medical complications and without losing the quality of attention (9).

The population health needs and the increasing financial pressures require health systems to adopt new approaches to the provision of health care. This National Telehealth Program will provide a broad system of telehealth centers which will satisfy the three levels of health care requirements in Mexico. It represents a strategy of great impact to improve the equity and optimization of health resources and might lead to an efficient and high quality health system. It is also an appropriate methodology, to decrease the economic costs of health services.

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CubeSat Solution Proposal for The Lack of a Permanent Satellite Channel For Telemedicine Purposes in the Latin American Region

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Abstract-This paper presents our design concept and some technological aspects in our ongoing project, "CUBESAT-UD" which stands for "Pico-satellite for Telemedicine solution and Innovative Educational Projects, according to the scenario where Colombia as SPTIVCEA (Secretariat Pro-Tempore of the Fourth Space Conference of the Americas) has been working on educational projects following its plan of action. Therefore one of the projects generated inside the SPT IVCEA has been the Cubesat program as a way to access space technology in the academic sector. The benefits of the program are: Training human resources in Science and Space Technology and establishing and Infrastructure with the capability to develop Space activities. As a result the Satellite Laboratory in Distrital University has been designing and developing this Cube Sat Project since September 2005. Its mission is telemedicine and telemetry, Its goal is to establish a telemedicine payload that is about putting a test bed taking into account a virtual patient located on an isolated area and who will be attended by an specialist located far away. The minimum success criteria is to send tele-cardiology data of certain disease coming from the patient and transmitting it to the telemedicine center and finally resend the diagnostic. The SPTIVCEA is on head of Ministry of Outer Affaires and its focal point is Civil Aviation of Colombia.

II. INTRODUCTION

One of the most important applications and development of space technology is on the configuration of a satellite channel in order to bring medical services to isolated communities.

Latin American Region is composed of several areas located specially in the jungle where the only way to arrive them is by rustic ship called "chalupa". There is not any possibility that a doctor can work on these areas. Therefore the only way to assist people is by telemedicine. Documents issued by OOSA (Office of Outer Space Affaires). UN (United Nations) establish that un development countries do not use and develop space technology on the way expected in order to increase the quality of life of their communities, because of the lack of education of decision makers that will drive to investments and activities in the space field.

That is the reason why Colombia as SPTIVCEA (Secretariat Pro-Tempore of the Fourth Space Conference of the Americas) has been working on educational projects according to its plan of action. The SPTIVCEA is on head of Ministry of Outer Affaires and its focal point is Civil Aviation of Colombia. In consequence the focal point has been the leader of the Cube sat program in Colombia and Latin American [1].The project lets students learn how to develop satellites. The Cubesat is a Pico satellite of 1 kg of mass, cube shape and 1000 cm3.The Cubesat is designed by students and professor in the university and includes all the steps to develop a sixty millions of dollar satellite. Even the launching is included. The cost of the project is very cheap, maximum US$100.000; therefore achieving the project by a university is quite easy. The advantages of the project are: students learn "the know how" to build satellites and the University establishes an infrastructure where the satellites are built. This infrastructure is called laboratory. Moreover, The University can develop an aerospace program becoming the project sustainable. Students can place simple missions on Cubesats such as GPS, Telemetry, Telecommand and Telemedicine. Errors are welcome on these projects due that students learn through them.

Small satellites can accomplish many of the same functions of their larger counterparts at a fraction of the cost and design time, making them excellent for telemedicine data, quick-response science missions, ad hoc communication networks, component evaluation, and technology demonstrations. As a result, there has been an explosion in the amount of small-satellite projects. Indeed, many United States government agencies, including the Defense Advanced Research Projects Agency and the Jet Propulsion Laboratory, in addition to companies such as the Aerospace Corporation and TRW, are all working on small-satellite projects [2]-[5]. Capitalizing on this new interest,

Professor Robert Twiggs and Andrew Kalman of Stanford University's Space Systems Development Laboratory developed the Cube Sat program to expose students to the various aspects of small-satellite design, manufacture, and operation [6]. Design constraints include a mass no greater than 1 kg and a maximum volume of 1000 cm3.

The definition of the mission success criteria were defined in an incremental manner:

(1) Education of engineers and masters, practical experience with designing space system

(2) Acquire a signal from the satellite

(3) Acquire comprehensive housekeeping data for system evaluation

(4) Use the telemedicine data for scientific outreach mission and performance evaluation.

On the Cube Sat project, it is important to remember that it was constrained by: Short project (2 years from idea to launch), Very limited budget, Limited mass and power, Built by students with no prior experience with spacecraft design. The "CUBESAT-UD" will be completed in April 2007 and will transport to California Polytechnic Institute to undergo environmental qualification tests together with the other satellites to be deployed from the same deployment mechanism. From California it will be transported to Russia, where it was functionally tested and the batteries were conditioned before being launched.

III. SATELLITE DESCRIPTION

The satellite subsystems that are essential for operation makes part of the satellite system. These include the Power Supply Subsystem (PSS), Communications Subsystem (CS), and Mechanical Structural Subsystems (MSS), Attitude Determination and Control Subsystem (ADCS), along with the satellite's onboard Data Processing Subsystem (ODPs). The following paragraphs will describe an overview of the architecture of a pico-satellite. As already described the satellite has dimensions 10x10x10cm and mass 1 kg.

In general for the electrical subsystems industrial graded components were used of the shelf. Some of the more critical components CPU's and MCU's have been tested to exposure of one year equivalent radiation dose.

In addition to these electrical subsystems the satellite consists of the structural subsystem, ODPS, PSS subsystems and a ground segment has also been developed for the project. The following paragraphs will describe each part in a little more detail.

A. Power Supply Subsystem (PSS)

The spatial autonomous system design requires a maximum efficiency as for the energy management, there are a simple calculus of power delivered to the system keeping in mind all the geometric factors and technical specifications of the components to be used. These calculations are based on the supplied power average requests by the design engineering team of the Cube Sat project. The objective of the system is to provide dependable power for all the modules of the satellite. Cube Sat UD, uses a system of basic power divided into the sections: solar Cells, Batteries, power distribution Unit, the circuits Latch-up and the Telemetry.

The main purpose of the PSS is to take power from the solar cells on the sides of the satellite and store it in the batteries as well as deliver it to the other subsystems of the satellite on a 5V power-bus and protect these users from latch-ups caused by radiation. The PSS consists of solar panels, electronics and batteries.

A conservative estimate of average input power is about 1.4 W. This power estimate constitutes one of the major constraints in the design and has been the driving force behind many design decisions.

The acquired energy is either consumed by the other subsystems or stored in the battery pack. The batteries are 4 Lithium-Ion polymer cells with a capacity of 940mAh each, giving a total capacity of almost 4Ah.

B. Mechanical Structural Subsystems (MSS)

The MSS team is responsible for the thermal, thermal stress, and dynamic modeling of the satellite, as well as for the design and fabrication for all of the support structures for the on-board components. The thermal modeling effort includes the development of a computer code written specifically to simulate heat transfer in the Cube Sat.

The numerical code features a hybrid resistance-capacitance finite volume formulation that accounts for heat transfer by conduction and external radiation as well as transient effects. The inclusion of internal radiation in the model is based on the resulting temperature gradients and a resistance criterion. The numerical analysis is then used to optimize the thermal design, which is based on the restrictions of the electronic components.

C. Communications Subsystem (CS)

The main purpose of CS is to receive signs of telemetry of the satellite like internal, external temperature, quantity of light, temperature of batteries, load of batteries, GPS, space in memory, data of 5 electrocardiograph signal for passing. It is composed by: Transmission and reception antenna, Rotor with their control system (RS232 ProSisTel), azimuth system and elevation model (PST75-12 ProSisTel), Computer - PC (YOU: XP), GPS System Tyco marks model Electronics A1021 with its external antenna.

Ground Station: the main part is the antenna, WX-706 from RF-connections was chosen. This is a 2X18 element crossed Yaggi directional antenna, with a gain of 14 dB. Since this is to small a gain to uphold the requirements of 15 dB, two of them where acquired and set up in a parallel configuration, as can be seen and thereby raising the gain with 3 dB and ending up with a total gain of 17 dB. The Figure 1, shows the sketch communication subsystem.

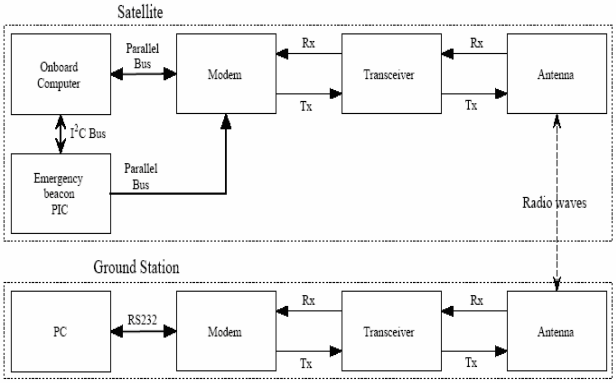

Figure 1. Sketch Communications Subsystem

The FSK-ASK Transceiver is ADF7020 433Mhz. The Receptor it includes the whole hardware, filters, amplifiers, Used etc. to carry out the transmission and reception of the radio signs in the antenna, the hardware should operate half duplex, the transceivers are programmed in the uplink frequency 433 Mhz and Down Link 915 Mhz

Receiving ground station Down link, for the station can serve the radii in 915 of micro hard Spectra 920 - Enclosed Wireless Modems, but if it is possible to find radios for earth with sensibility of -121 dbm, it would be is better.

The antennas are mounted on a tower and by the help of two motors they can be turned both around and up-down and this is controlled by the PC. A

D. Attitude Determination and Control Subsystem (ADCS)

The objective is to provider a positioning global system, it is composed by: Sensor Systems, Biaxial Magnetics,3-Axial Inertial Correction System, Diffused Micro controller System, Tyco Electronics GPS A1021, low power, weight and size reduced.

E. Onboard Data Processing and Control Subsystem (ODPCS)

This is the, interface between the communication subsystem and the micro controller, data mission, power control, temperature sensor, position control, diagnosis control of solar panels. It contains: principal processor, micro controller MSP430, CPU de 16-bits RISC technology, 3.3 MHz clock, 16KB in memory, RAM 512, Communications input/output ports, 3.3 – 5.0V operation voltage. Development software is Salvo Pro RTOS and development tools are Cross Works for MSP430 de Rowley Software. The f Figure 2, contains a description on this subsystem.

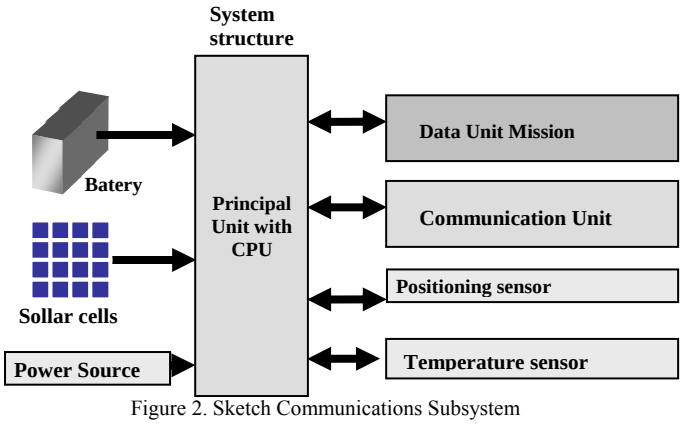

Figure 2. Sketch Communications Subsystem

IV. MISSION PAYLOADS

The Distrital University's CubeSat project is able to accommodate two separate payloads, despite the 1-kg weight limit. The main payload consists of an experimental telemetry and the second is telecardiology for telemedicine research.

Current CubeSat communication systems operate in the VHF/UHF range, which may not be able to accommodate future, data-intensive CubeSat missions such as the lunar and Mars missions in 2006-2007 [7]. Then it is very important to develop research to qualify engineers in development of satellites for terrestrial solutions.

The second mission corresponds to use a telecardiology system in the terrestrial portion of the system where de CubeSat will be used to transmit compressed data to other remote regions to provide services of basic attention in health. The telecardiology system is presented in [8], [9], it was tested on internet.

Also and between the secondary objectives it will be studied the possibility to implement a KatySat Mission.- Kids are not too young for satellites [10], [11]. For example, the establishment of worldwide audio broadcasting that joint with Ground Station at some Colombian Schools will let K-12 Education on Science and Space Technology. This project was born in Stanford University and "CUBESAT-UD" team will support the KatySat Team in some aspects.

V. EDUCATIONAL PROGRAM

The Distrital University has been started a new educational program in the Master of Science in Communications and Information System with the former students in Satellite Networks where the cube sat program is the first experiment to be developed: Its study plan includes five specific modules on satellite networks and the laboratory is the support to develop research in this area.

VI. CONCLUSION

In conclusion the CubeSat project has achieved three major results: Primarily a large group of students will leave the university with a great deal of "Hands-on experience" within satellite design and experience with working with a large project that requires cooperation between everybody that are involved. Secondly, with the development of small

satellites it can begin a space career for countries that have not been immersed in these scientific fields, finally, it is important that the satellite system provides facilities for solving social impact problems as those that correspond to the health field.

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Project of Social Connectivity for the formation and development of local capacities by More and Better Health in countryside and small localities of the Argentine territory under communication platforms (SAT/WiMAN-WiLAN/PC).

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Two projects in execution with international sponsor: evaluation protocol, participative research procedures and quanti-qualitative strategies.

I. INTRODUCTION

Era Digital Foundation, with central place in Rosario (Santa Fe - Argentina) through its Department of Investigation and Development plans and executes different projects, whose objectives prioritize: communitarian participation, economic development, educative opportunities and improvement of the health; always considering the initial conditions given by the reality context in which there are to execute itself.

Two projects in execution stand out that they have by purpose of implementing a platform of wireless communications in networks of cover MAN - LAN by means of WiFi standard and access to Internet by satellites route, whose appropriate convergence and integration estimate an opportunity for formation, education and development of such local capacities by and better health in as much more approaches these communities the alternatives of Telehealth in general and Telemedicine in special.

II. EVALUATION PROTOCOL

First of these projects: "Evaluation of radio networks (wifi / satellite) applied in platforms of telehealth" sponsored by IDRC - International Development Research Centre (Canada - Uruguay) and CIDE - Centro de Investigación y Docencia Económicas (Mexico) involves an axis of location between the cities of Córdoba and Catamarca (center-nor-west provinces).

Between his objectives it emphasizes the necessity to develop and to validate an evaluation protocol that considers inherent the objective and subjective conditions to the inclusion of these technologies in the existing services of health. These services are destined mainly to end users, whose location will be given in hospitals of reference of these provinces and peripheral centers of health such.

This protocol, on the base of the historical-social and ecological-environmental conditions, tries to evaluate four aspects: a.- Institutional (i.e. organization, infrastructure, financing); b.- Technological (Hard, soft, informational, communicational); c.- Telehealth (knowledge, accesses, applications); and d.- Health (personnel, services, benefits); in each one of them a series of respective aspects is delimited (e.g.):

a.- Institutional (impacts): costs-benefits, documentary registries, expectations, sensitivity, routine, satisfaction, investigation and development, ethical-politician, public health.

b.- Technological (updates): hard/soft and comm./wi/sat - digital break, standards on the supported information and communication, manual and guarantees.

c.- Telehealth (specificity): platform, incremental map, costs-benefits, utility (according to center / service health), applications, expectations, sensitivity, specific knowledge, professional formation (TIC and Telehealth), education, investigation and development.

d.- Health (improvement – "more and better"): Users – population, social knowledge, cultural expectations, demands more frequent, regional epidemiologist, professional habitual "good-bad" practices, work conditions, social improvements - popular education.

Within each one of such aspects joint complexes of variables have been delimited that conform them. After studying the possible methodologist alternatives, in the same one they have been privileged and delineated to the date the following instruments:

1.- Tables for Documentary Analysis:
   (a) Centralized
   (b) By sector or aspect
2.- Guides of Observations (general)
3 - Guide of Interviews
   (a) Brief (20´)
   (b) Intermediate (30´)
   (c) Deep (50´)
4 - Guide of Group Dynamics
   (a) Initial (minimum: 30´)
   (b) Intermediate (minimum: 50´)
   (c) Extensive (minimum: 90´)
5 - Guides of Study of Field
6 - Guides for Observacional Designs
   (a) For pre-established situations or specific periods
   (b) During daily passing of activities
   (c) Controlled Observations - experimental Designs
7 - Questionnaire
   (a) Boundary of contexts of reality
   (b) Initial evaluation (present state)
   (c) Intermediate evaluation (execution processes)
   (d) Evaluation end stages (of results)

A technological revolution exists that favors all those initiatives with tendency to communicate citizens, groups, institutions and peoples. We assumed that all project estimates its modification and improves from the applications and agreed replications to each situation, inside each context of reality.

III. More Methodology Strategies

The other project: "Project Pilot of Social Connectivity (commune, hospital, schools, small companies, libraries) in countryside and small localities of Argentine territory under communication platforms (the SAT/WMAN-WLAN/PC)", sponsored by FRIDA Program - Regional Found for the Digital Innovation for Latin America and the Caribbean, sustained by LACNIC - Latin American and Caribbean Internet Addresses Registry. In this case a partnership jointly with National Technological University has been integrated (UTN Rosario); Federation of Telephone Cooperatives (FECOTEL Argentina) - Cooperative Telephone of San Gregorio (San Gregorio) and Ecumenical Movement for Human rights (MEDH Rosario).

It is located between small urban centers and rural spaces of the floodable lagoons zone the Picasa (South of the province of Santa Fe). This service, initially planned for the locality of San Gregorio, at the moment ties also with its neighbors: María Teresa, Diego de Alvear, Christophersen, Colonia Morgan; and presumably others more. Small communities with relative shortage of resources and smaller presence in the habitual circles of being able and decision, outside the radius considered income-producing in the national market.

The digital inclusion of small localities continues being at the moment problematic in a country like the Argentine Republic, that shares social segmentations economic, territorial and similar very common and others not so generalized with all Latin America and other regions of the world. The digital break in TIC (just as it concerns to other technologies) reproduce to the interior of their societies, adding new unfavorable conditions to come near to the standards of the Information Society - Knowledge Century, the plans related to popular initiatives and the routine character of the human rights, health including.

Even so, in Argentina, the province of Santa Fe (and altogether with other few) presents/displays some relatively better indicators in diverse demographic, social, educational, sanitary and economic matters. When crossing these communities we found evidence sufficient to affirm the coexistence of:

a) daily spaces where the present and potential capacities and developments are prevented or remain idle without appropriate advantages;
b) the existence of organizations with local capacity of involvement, the presence of professionals and experts with commitment, with capacity of update and formation of other fellow citizens who mean propitious objective and subjective conditions to advance in such interdependences between problems and possible solutions;
c) the presence of organizations who could contain projects of innovation like this, project their future continuity by means of sustainable local management and as much strengthen favorable bonds and agreements to the local development summoning to such aims to other organizations of the own communities like a the next universities; combining as well efforts of convergences between social actors, the public and deprived sector of the locality.

By all it east project assumes and defines essential the absolute inclusion of participants local, including of tie students and graduated with the specific objectives as the same one, the communitarian development as much implies greater potentiality to the citizens as to its key institutions, that in the diversity of communities, each one of them and from its local cooperative, their participants will be able to make sustainable according to their own identities, visions and projects to these key institutions: Commune, Services Public, Hospital, Schools (urban and rural), Popular Library, social Center of Commerce, and other cooperatives and groups. Soon between communities, forming opened and progressive regional infrastructures.

The social and human communication uses to power with the use as these new TICs organized like communitarian platform of connectivity to Internet, facilitating (for information and formation, products and services, public and

private) the access to more and better resources in/out of line. As a example of areas of direct incidence they are possible to be considered, among others, the one of the health: resources in line, telehealth and second opinion, preventive anticipation of events and management of services, identification and focused election of institutions, services and workers of the health... In this context, the sense and meaning of a project of this type are related totally to certain methodology: the methodology strategies correspond with participative research procedures for the educational and organizational aspects, quantitative strategies for control of the technological subsystems and quantitative-qualitative strategies for the progressive pursuit of the impacts of the implementation of the platform, of within the framework institutional sensitivity, professional good practice ("praxis") and the strategies of social learning.

This allows us to recover the objective and subjective conditions that are interlaced in significant a complex totality, that it is developed in the daily life and history of all these communities. In the field of the health also.

IV. Provisory Conclusions

This preoccupation is based on the evidences of third and own ones, in very diverse fields, through which well it is recognized that in this field (in the present state of knowledge and applications, with the methodologist tools and procedures of evaluation available and used) the results are not easily to generalize conclusions nor from safe extrapolation to other situations.

Between different countries or communities their differences from contexts and systems of health, for example, can make inapplicable in accomplishments made specific in others, kind to demographic, social and cultural populations differences, their traditions and conceptions of health and disease, concurrence and access to the services of health, the costs of the resources, praxis of the professionals of the health, the previous formation and imaginary and the representations of and other respect to these technology and telehealth, until including the morbidity indices (real or believed by the reference communities) that can be registered in the areas in which these resources are applied.

Nevertheless, these projects have the intention to serve necessarily the specific local experience in which they are inserted, and to cooperate with similar experiences: to shorten the digital range - social impoverishment.

Projects of social connectivity & local capacities = nTICs & Telehealth = Promoting More & Better Health.

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Evaluation of Video Educative Material for Patients: A Pilot Scheme in 12 Public Health Facilities of South Africa

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BACKGROUND

In South Africa there is a very high prevalence of HIV/AIDS. An essential means of combating this is to provide relevant information to those who may become infected with HIV (HIV+), or are already HIV+. A pilot study conducted in 2003. In 2005 patients in 12 public health service clinics/hospitals located in 6 provinces of South Africa, were exposed to a Health Channel (HC). The HC comprised presentation of selected material on HIV/AIDS, via a TV screen. It lasted about 60 min. This work evaluated the pattern of use of the HC and its self reported educational impact determined through questionnaires. This is believed to be a unique project in sub-Saharan Africa.

METHODS

Two groups of patient respondents, "Subjects" (N=180) and "Controls" (N=239), participated. The former viewed the HC videos in public waiting areas. The HC included topics on treatment and management of HIV/AIDS, Anti Retroviral (ARV) drug regime adherence and side effects and understanding the significance of "CD4 counts". The "Control" group consisted of similar patients who instead viewed dramas depicting daily life of HIV+ persons. The institutions selected for the study were in urban, periurban and rural areas. Respondents were adults of all age groups and living in a wide range of types of residential area. The study methods included a questionnaire to determine respondents' demographic characteristics, prior knowledge and attitudes concerning HIV/AIDS and from a second questionnaire, changes after exposure to the HC. Also there were direct observations while the respondents viewed the HC. Questionnaire data were captured using EPI Data and analysed with STATA 8 software. Thematic content analysis was used for qualitative data.

RESULTS

There were initially no statistically significant differences apparent in increased knowledge, after viewing the HC, between the two patient groups taken as a whole, although all had a generally high level of awareness of HIV/AIDS material. However, after a more detailed analysis, some statistically significant ($p \leq 0.05$) differences were detected when correlations with gender, age, medical condition of the patient and home location (whether urban, rural, etc) were considered. More knowledge existed for those in townships, than elsewhere and for non-rural females and for those <35 years old. Future HC material will be modified by the following findings: large gaps exist in the public's knowledge (especially for ARVs) and drama format for the HC was far preferred to documentary format.

CONCLUSIONS

Overall the HC was very well received and its present format is moderately effective for increasing patients' grasp of relevant matters concerning HIV/AIDS. Although the HC provided improvement in knowledge, understanding and attitudes for patient respondents, it only became apparent after correlation analysis. However information was gained that will lead to a more effective post-pilot HC.

Key words: *HIV/AIDS, Health channel*

Applications of Satellites in eHealth

M. Bernat, R. Rettig, L. Braak

MEDES French Institute for Space Physiology and Medicine

MEDES is a group of economic interest created in 1989.

MEDES's objectives

- To assist in the medical supervision of manned flights and the preparations for future interplanetary manned missions.
- To capitalize on the results of space research on the areas of Healthcare.

Satellites offer several services relevant to e-health

- Access to communication in remote areas or mobiles, including broadband and multicast services
- Localisation
- Remote sensing

MEDES ONGOING SATELLITE APPLICATIONS

DISTANCE EDUCATION

Rationale for using satellites:

Satellite offer access to broadband and multicast telecommunication capabilities. The availability of interactive television technologies enables to provide educational services "at home".

Projects and perspectives:

∫ **EDUCAD**: Health education for diabetics by satellites (Evaluation in 2005).

∫ **Planete Vie:** Collaborative web base platform dealing with relations between Life and Environment.

www.planetevie.org

Objectives:

Development in partnership for educational services.

TELECONSULTATION

Rationale for using satellites:

Satellites offer access to telecommunication in remote areas, mobiles, and in disaster situations.

Projects and perspectives:

∫ ET ASSIST – Ten Telemed. Development of ehealth services.

∫ Creation of the telemedicine Technologies SA company in 2000.

∫ Portable telemedicine workstation DELTASS - IDISCARE.

∫ Operational network in Guyana (20 isolated sites since 1999).

∫ Demonstrations for maritime and aeronautical an disaster medicine.

∫ Creation of the MEDESSAT company in 2005 **www.medessat.com**

Objectives:

Development of services for disaster medicine.

ENVIRONMENTAL EPIDEMIOLOGY

Rationale for using satellites:

Satellites provide access to communication for epidemio-logical surveillance, and remote sensing data enabling to feed data for predictive models of environmental related diseases.

Projects and perspectives:

∫ EMERCASE: Operational network in Senegal since 1999.

∫ Creation of the S2E "Surveillance Spatiale des Epidémies" consortium in 1999.

∫ S2E Argos : Operational network in Niger since 2005.

Objectives:

Development of services for early warning.

MEDICAL ASSISTANCE

Rationale for using satellites:

Satellites provide access to communication and localisation.

Projects and perspectives:

∫ VTAMN : Development of a prototype of smart suit 1999.

Objectives:

Contribution to develop and evaluate services for ambulatory monitoring.

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Space Technology for Telemedicine in Extreme Environments and Disaster Response

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Abstract-We report the use of space technology, especially satellite communications, to validate telemedicine systems for use in remote environments.

I. Background

The developing world has a number of barriers to effective healthcare information sharing in remote areas. Among the barriers are limitations in reliable means of transmission, and the dynamic nature of most connections. For many years, NASA and other space agencies have recognized the need to overcome similar barriers in caring for the space explorers' healthcare needs [1]. To these ends, our group has investigated the use of radio, telephone, and satellite transmissions for use in the integration of the primary and secondary health services in remote areas of Ecuador (with applicability to space and other remote locations) [2-13].

These solutions using space technology, while designed to support space agency missions, also provide useful solutions to areas with communications problems on Earth. As demonstrated in Figure 1, these solutions enter a cycle of development and validation, both terrestrially and in space, and usually help both the intended recipients and the test subjects. We have developed solutions for medical support in extreme environments, of various capabilities, using various communications modalities.

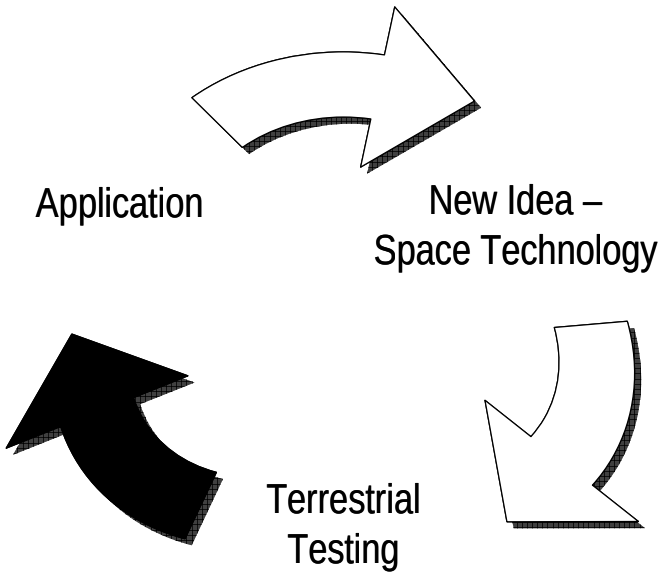

Figure 1. Creative flow for Space Technology, involving terrestrial testing and application.

II. Materials and Methods

F. Multimedia Telemedicine Workstation

We developed a multimedia telemedicine workstation, as in Figure 2, which would incorporate various forms of data, video and still images into a coherent, longitudinal electronic health record [14]. The electronic health record was developed using Microsoft Access © (Redmond, WA). Other components of the system were based on off-the-shelf technology, keeping the total cost ~ $1200 USD.

The telemedicine workstations were placed in four sites in various provinces of Ecuador, three primary care facilities, and one surgical specialty (Fundación Cinterandes).

G. Radio Communications

Radio communications have long provided a means of voice communications in terrestrial areas without other services, and in times of breakdown of standard telephone communications. Radios may also provide a means of data transfer, and, even image transmission – though at extremely slow speeds.

H. Plain Old Telephone System (POTS) Communications

Telephone modems have become standard equipment for most computers today, with speeds of 56 Kbps, at best.

I. Satellite Communications

We have used the InMarSat B portable satellite telephone system, with 64 Kbps Integrated Services Digital Network (ISDN) modem for data transfer. We transmitted surgical cases with real-time video using two identical InMarSat phones connected in series, for 128 Kbps total transmission speed. We have also performed teleanesthesia using only one 64 Kbps InMarSat phone.

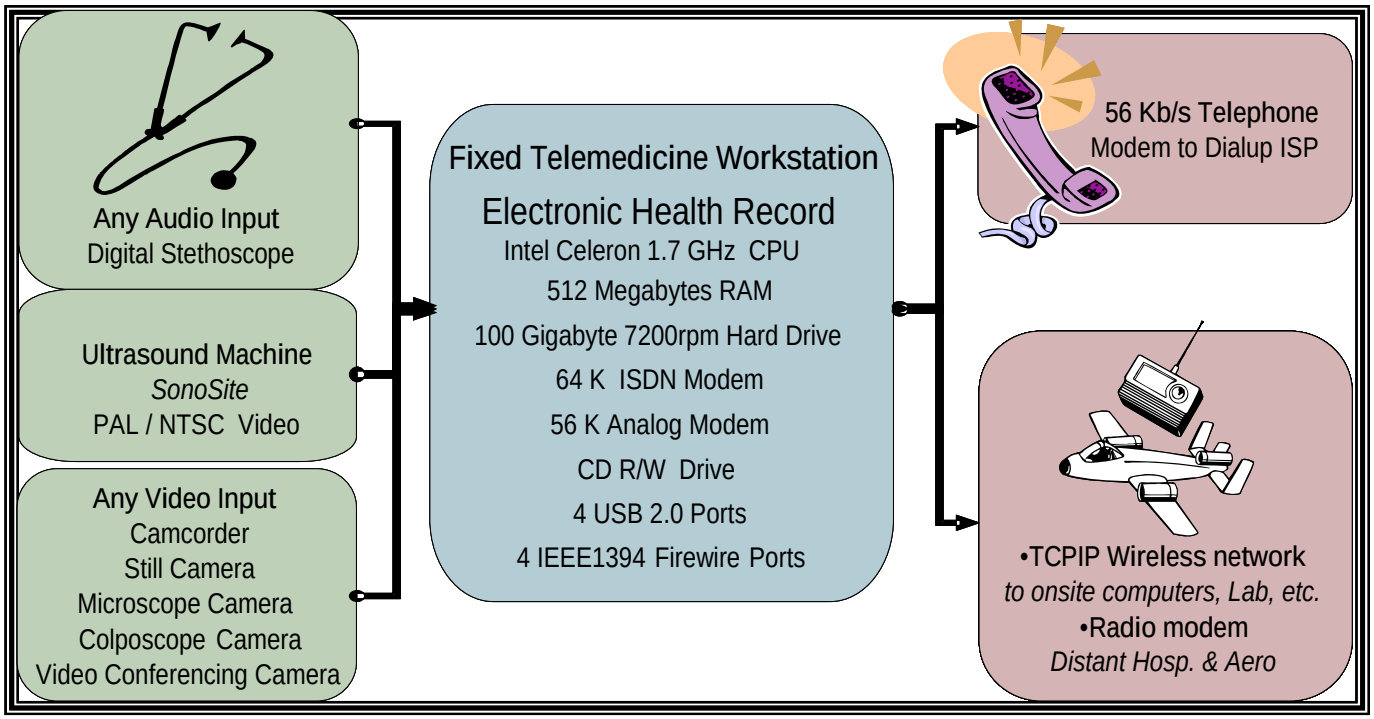

Figure 2. Telemedicine Workstation Setup, with multiple input and output devices.

J. *Rapidly Deployable Telemedicine Unit*

We have developed the Rapidly Deployable Telemedicine Unit over many years, honing to its present configuration and capabilities. Current communications modalities are displayed in Figure 3.

III. Results

Radio, today, still provides an adequate means of communicating by voice with distant sites. Though we have used this system for data, even image, transfer, this method proves much too time-consuming for practical application.

In truth POTS communications may be limited by local Internet Service Providers (ISPs), commonly only providing 22 Kbps in Ecuador. Yet, this has proven to be adequate for most store-and-forward applications in place [3;8], with some limited videoconferencing (low resolution and pixelated).

Satellite connectivity generally provided adequate bandwidth for all applications. Real-time transmission (at 128 Kbps) of high quality video images during surgery, with distant confirmation, has been demonstrated [15]. Anesthetic monitoring has been accomplished with half that bandwidth, with full real-time transmission [4].

IV. Discussion

During times of disaster, healthcare and communications systems may be adversely affected and reduced to levels considered substandard in the developed world. In these instances, such as in response to the Hurricane Katrina disaster, lessons learned from our work in remote, extreme environments helps provide a means of support and otherwise nonexistent connectivity.

The technical solutions available are as varied as the barriers to be overcome and the populations in need. .

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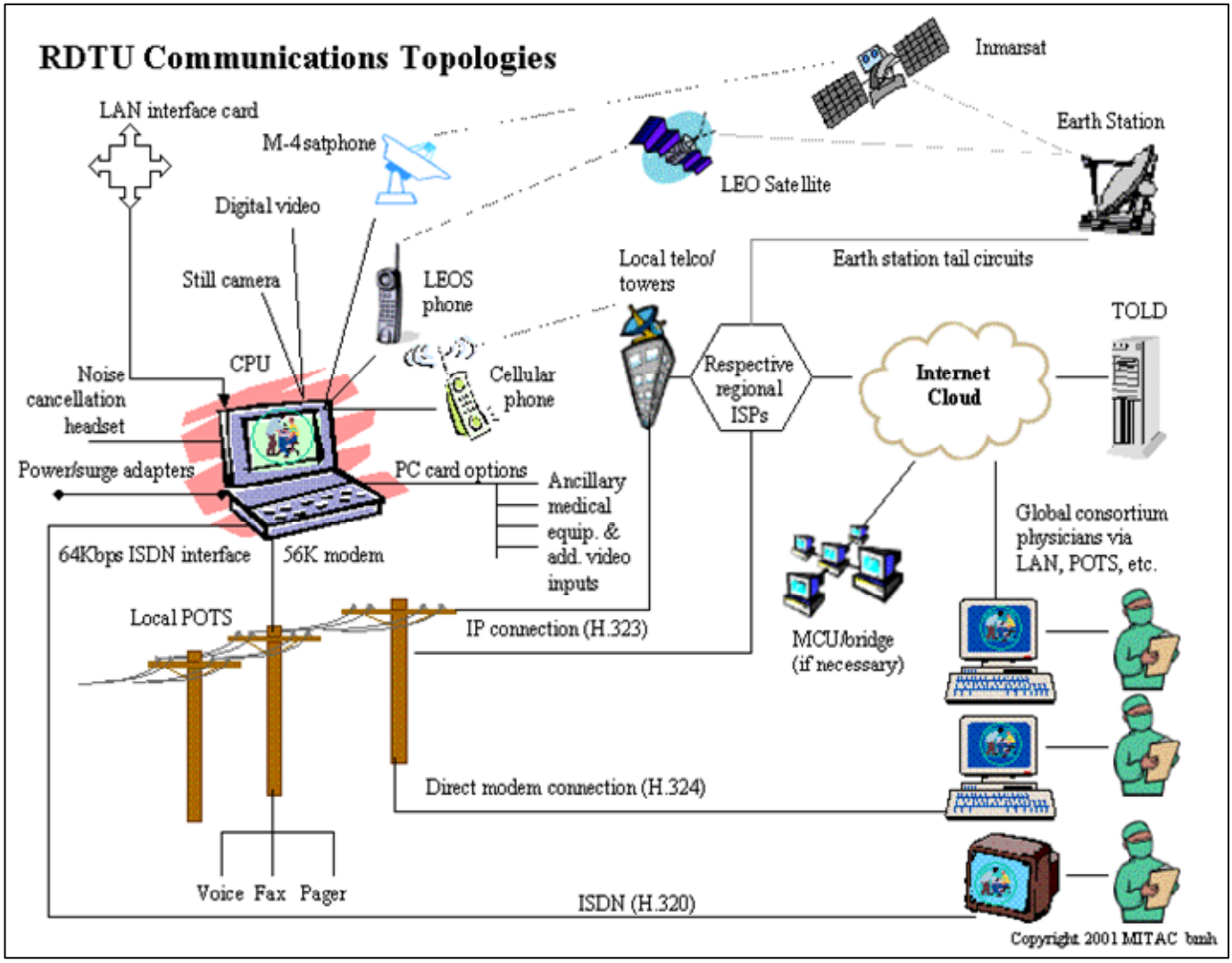

Figure 3. Multiple communications modalities available for use with the RDTU.

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Integral Evaluation of Malaria in Tuntunani (Bolivia) at 3800 Mols.

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ABSTRACT

We have unusual local malaria outbreak (January -May 98) in Andean high land to 3800 mols. These cases have strong relationship with climate and variability changes, and ecosystems modification

INTRODUCTION

The climate change could affect human health in direct and indirect form, one of this effect is increasing vector borne transmissible diseases incidence. We are looking, to grow geographic endemic areas and rise altitudinal level, where never before presented this type of illness. As local malaria in Tuntunani –Bolivia (3800 m.o.l.s) situated in Andean region in 1998

OBJECTIVE

To evaluate malaria outbreak in Tuntunani, Andean region of Bolivia, since an integral perspective.

METHODOLOGY

We made climate change and variability scenarios, comprehensive ecosystem evaluation searching vectorial habitats modification in highland, (Tuntunani, Mollebamba and Sehuenkera) and using satellite imagines and geographic information system for epidemiological integral assessment (surveys, clinical examination, laboratorial test)

RESULTANT AND DISCUSSIONS

The local malaria outbreak from January -May 98 in high land to 3800 mols., was the first time, that present local malaria at this high altitude and it has relationship with climate change, because traditional climate of this area was cold (10 to 15 °C), but since 1991, we are registered warm temperatures in relationship to base line 1960 -1990. This modification, have ecosystem and vector impact, producing ecological conditions for vector development and we found it there. Furthermore, the strong ENSO event 97/98, increased surface sea level temperatures (table 1) and produced in studied area; maximum historic temperatures and pluvial precipitation (confirm with NDVI index in January – May 1998, with sanitary impacts because is the same period of high land malaria outbreak.

Seasonal classification: Surface Sea Temperatures for South America 1996 -2000

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1996	C-	C-	C-	N	N	N	N	N	N	N	N	N
1997	N	N	W-	W-	W	W	W+	W+	W+	W+	W+	W+
1998	W+	W+	W+	W	W	W-	N	C-	C-	C	C	C
1999	C	C+	C+	C+	C	C	C-	C-	C-	C	C	C+
2000	C+	C+	C+	C	C	C-	C-	N	N	C-	C-	C

The panoramic epidemiology, permitted identified the malaria outbreak location and others areas, with similar condition for development vector borne transmissible diseases in high lands

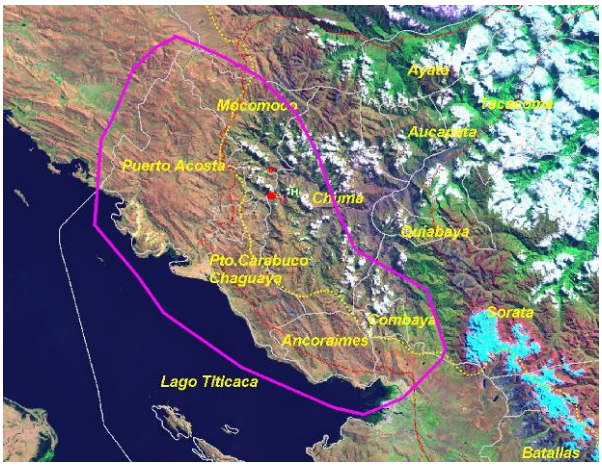

Figura 1: Panoramic view study area LANSAT 5

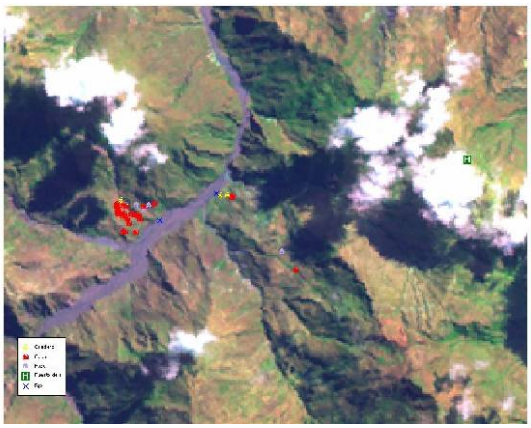

Figura 2: Tuntunani Malaria Cases with GIS identification

CONCLUSIONS

We had confirmed local malaria outbreak in January -May 1998 in high land to 3800 m.s.l.o

We identified climate change in this area, with important differences between base line and current climate. The strong ENSO event 97/98, forced climate condition and help to produce this disease.

Climate change is having ecosystems impacts permitting vegetation and weather condition for vector presence and development in this high altitude

KEY WORD: climate change, highland malaria, panoramic epidemiology

REFERENCES

WHO, Health Canada, UNEP "Methods of assessing human health vulnerability and public health adaptation to Climate change

The Remote Sensing Perspective to Focus Landscape Ecology, the Anthropogenic Action and the Malaria Disease

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ABSTRACT OF PRESENTATION:

The rapid growth of human population, the unplanned urban housing processes, the fast industrialization, the human forced population shifting due to better socio-economic conditions, the environmental impact with the consequent perturbation of ecological systems, all of them are responsible for the various changes in different levels at the world, regional and local scales, either temporal or spatial. Such changes are affecting the climate, causing alteration of its pattern, thus originating climatic instability that in turn alter natural system in a direct way and so the ecological system functioning. A good example of that are the metaxenic or vector driven diseases such as dengue, encephalitis, malaria, leishmaniasis and Chagas as well. This presentation shows, using satellite images and geostatistics models, the human activities and their relation to the malaria persistence in a regional approach. To achieve that, we analyzed spatial and temporal effects of agricultural and other common local activities in the Sucre State, Venezuela

Key Words: Remote Sensing, Landscape Ecology, Antropogenesis, Malaria Disease, Estado Sucre, Venezuela

INTRODUCTION

CAUSES OF CHANGE AT THE GLOBAL, REGIONAL AND LOCAL LEVELS BOTH SPATIAL AND TEMPORAL

- The rapid human population growth in the zone
- The urban uncontrolled process of Regional Industrialization
- Forced human displacement looking for better living conditions
- Environmental impact with the subsequent alteration of ecological systems

Those changes start affecting not only the clime but they are also causing a permanent alteration of Its pattern, witch in time end up in a climatic variability. Such variability directly affects natural systems and so the ecological ones (Delgado *et al.* 2004). An example of them are the vector borne diseases also called metaxenic diseases such as dengue, Leishmaniasis, Chagas, malaria, etc.

WHY MALARIA IS AN ECOLOGICAL SYSTEM?

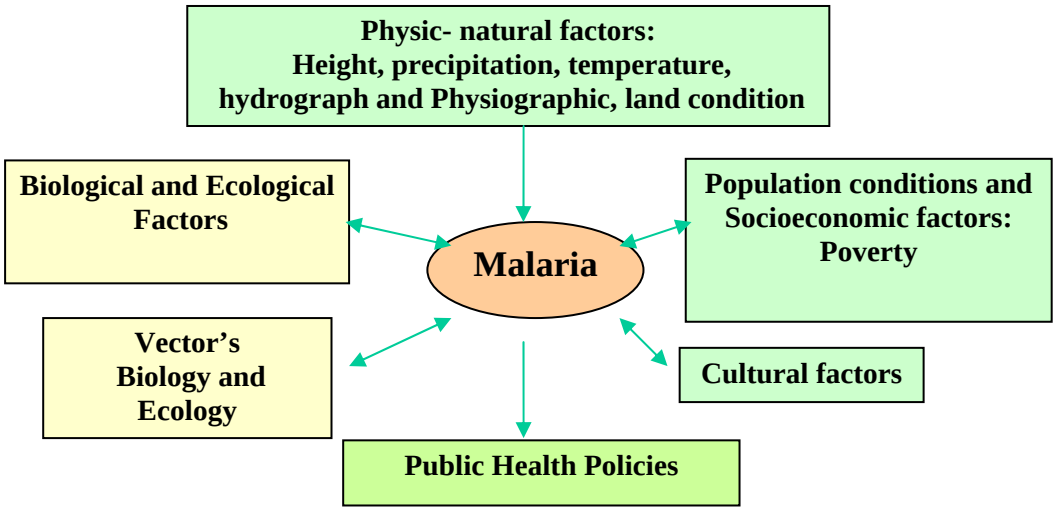

Figure.1 Schematic model of malaria system.

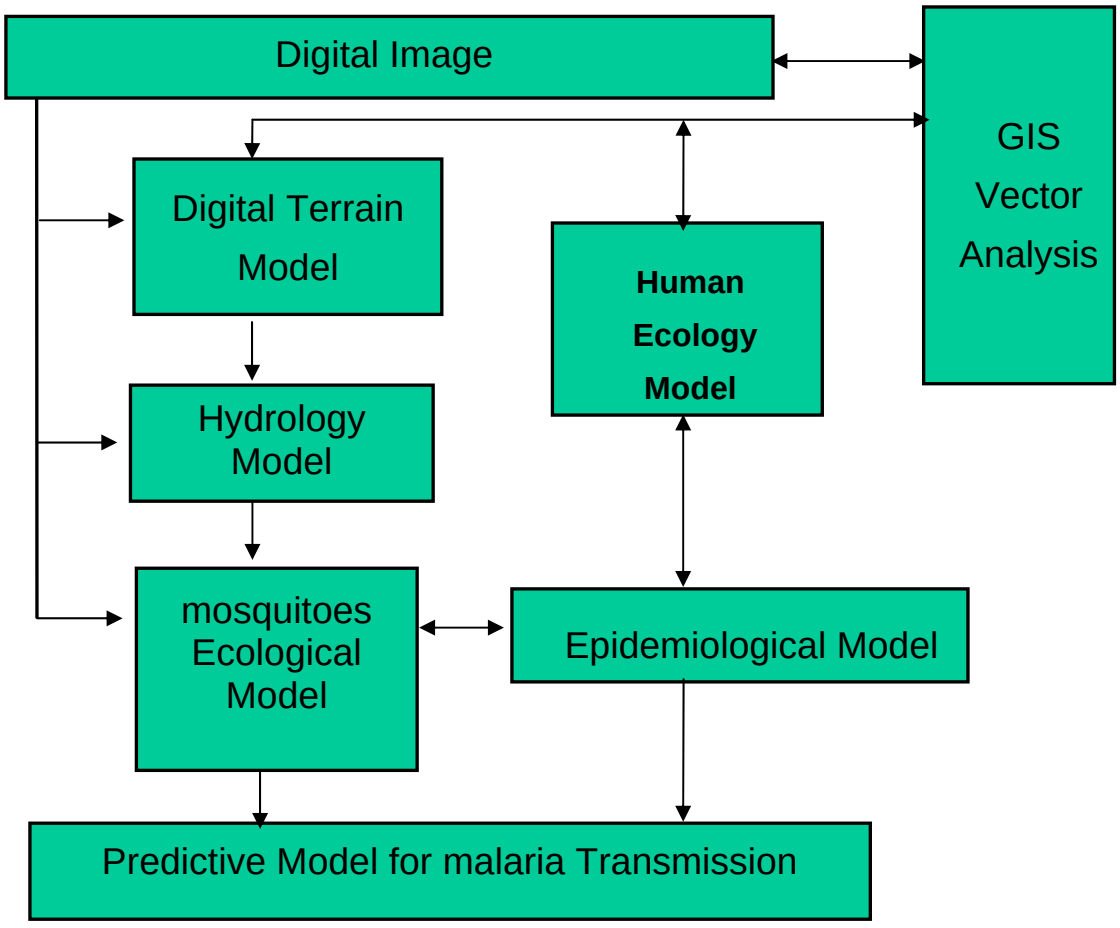

Figure 2. Conceptual Model. Modified from Wood *et al.* (1989)

Methods

THE STUDY AREA

The State of Sucre has an extension of 11.800 km2 located at the Northeaster of Venezuela between the 10°13'10" and 10°44'10"N and the 61°50'44" and 64°30'00"W. Enhanced is the Paria Peninsula and Its South slope between the parallels 10°27´00´´ and 10° 42´31´´N and meridians 62°32´00´´ and 63°11´00´´ W.

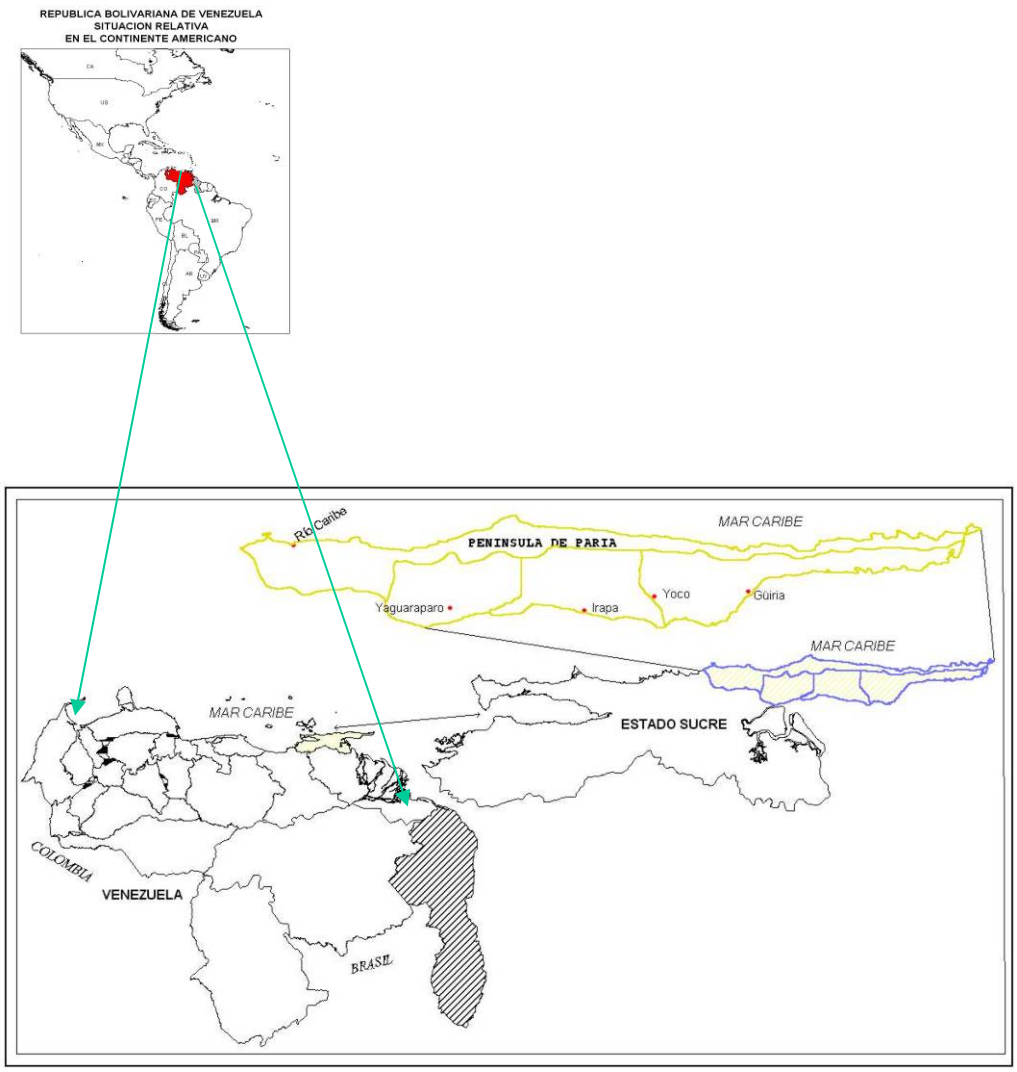

Figure 3. Relative Position

DATA SOURCES

Used socioeconomic data represented by Socioeconomic Indexes from INE (Instituto Nacional De Estadistica E Informatica; Venezuela) and INE-PNUD (2001, 1999): total population, urban and rural populations, urban development level, population growth rate, employment expressed as a fraction for main economic activities and employment opportunity as the most important.
Data derived from the Digital Elevation Model generated upon level lines at the scale 1:100.000.
Data derived from the Spatial Model of Malaria Regional Incidence years 1990 and 1999 (Delgado *et al*. 2001).
Digital Image processing: LandSat TM5-153. Dec 1990 and LandSat TM 7+ 153. Sept. 1999. Band combination 4,5,3 to quickly detect land use.
Fieldwork: *Anopheles aquasalis* breeding sites survey verified on the mentioned images locations.

Results

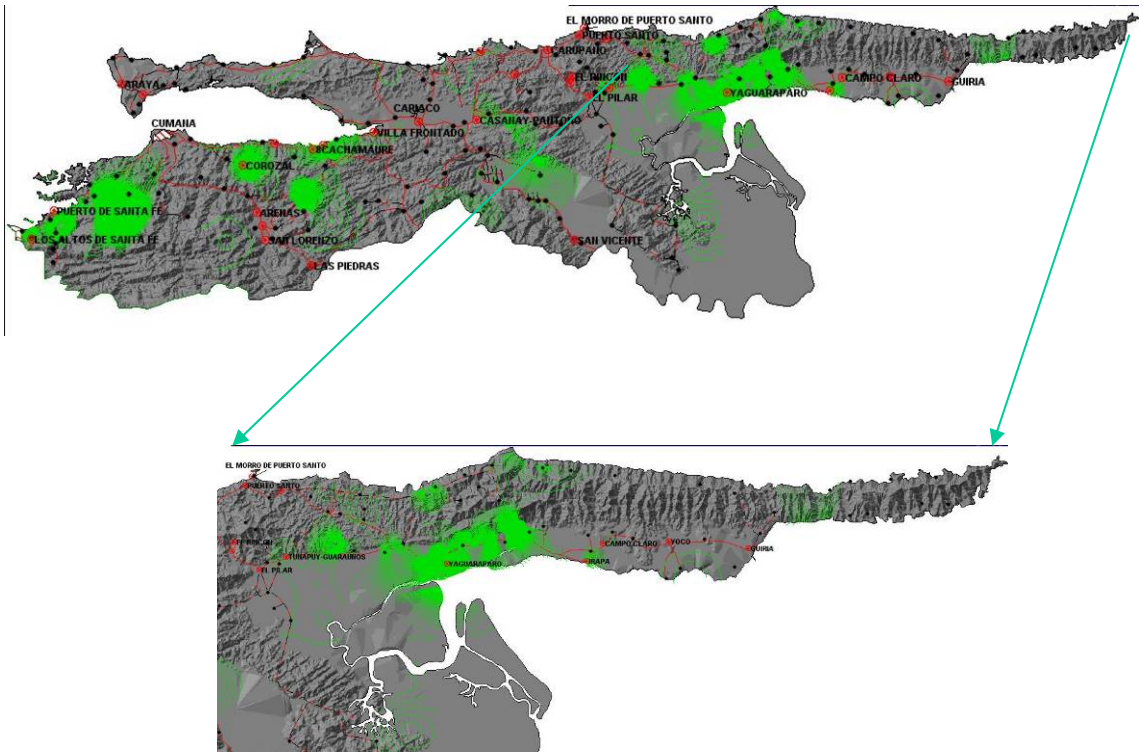

Figure 4. Terrain Model derived from the Topographic Lines at the scale of 1: 100.000

Spatial relation derived from the Model of Malaria Incidence 1990 and the Digital Terrain Model, expressed in terms of height and slope level. The analysis shows how to mayor focus of malaria incidence are assigned to localities within the lowest height and slope condition. (Fig. 4.)

The picture (Fig.5.) shows high heterogeneity and the plane zones with vegetal cover diversity, natural patterns and anthropogenic modifications.

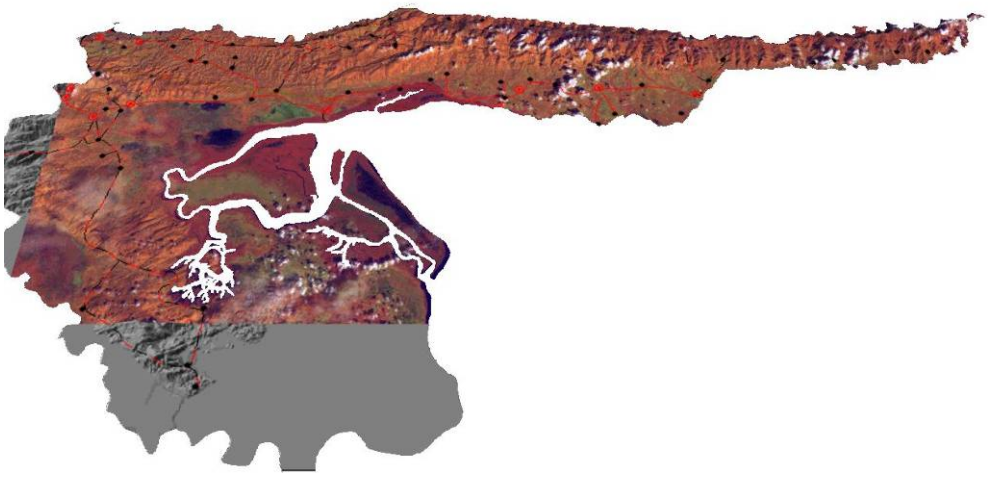

Figure 5. Combination of the image TM5-153- 1990. 4,5,3, bands and Digital Terrain Model.

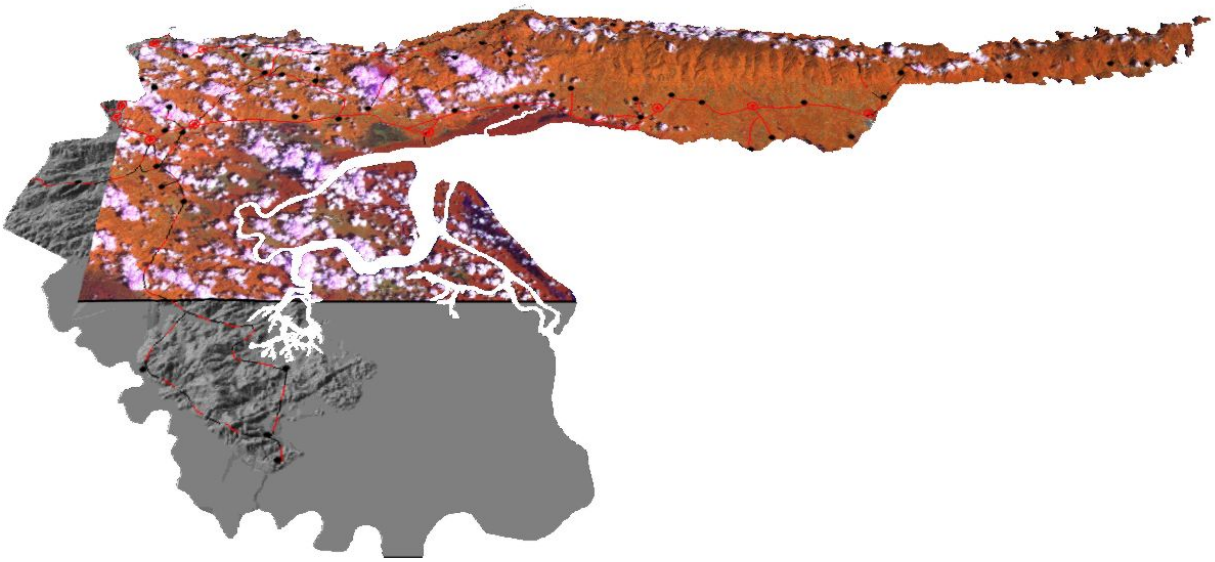

Figure 6. Image combination of TM 7+ 153 1999. 4,5,3 bands and the Digital Terrain Model.

The figure 6 shows on this more recent image and socioeconomic indexes coming from INE, permitted evaluation of changes as high, medium and low impact of man activities and to express some statistical meaningful relationship.

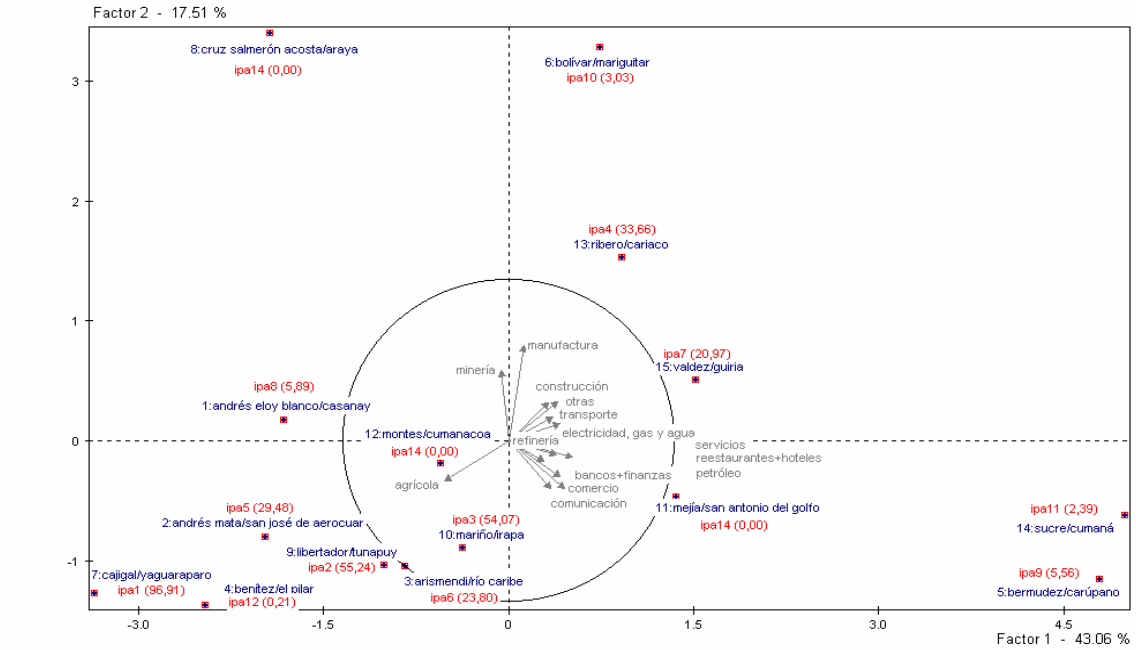

Figure 7. State of Sucre 1999-Principal Components Analysis Based On Ipa (Anual Parasitological Index)

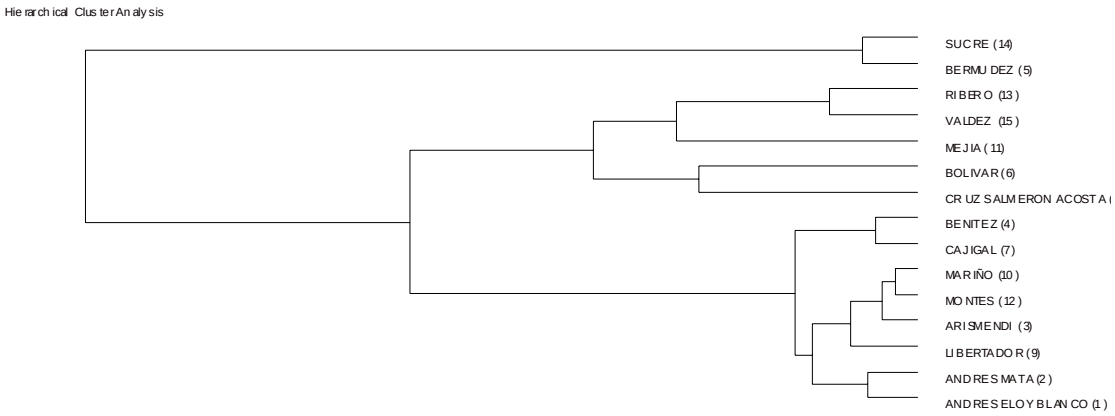

Figure 8. State of Sucre 1999-Hierarchical Cluster Analysis

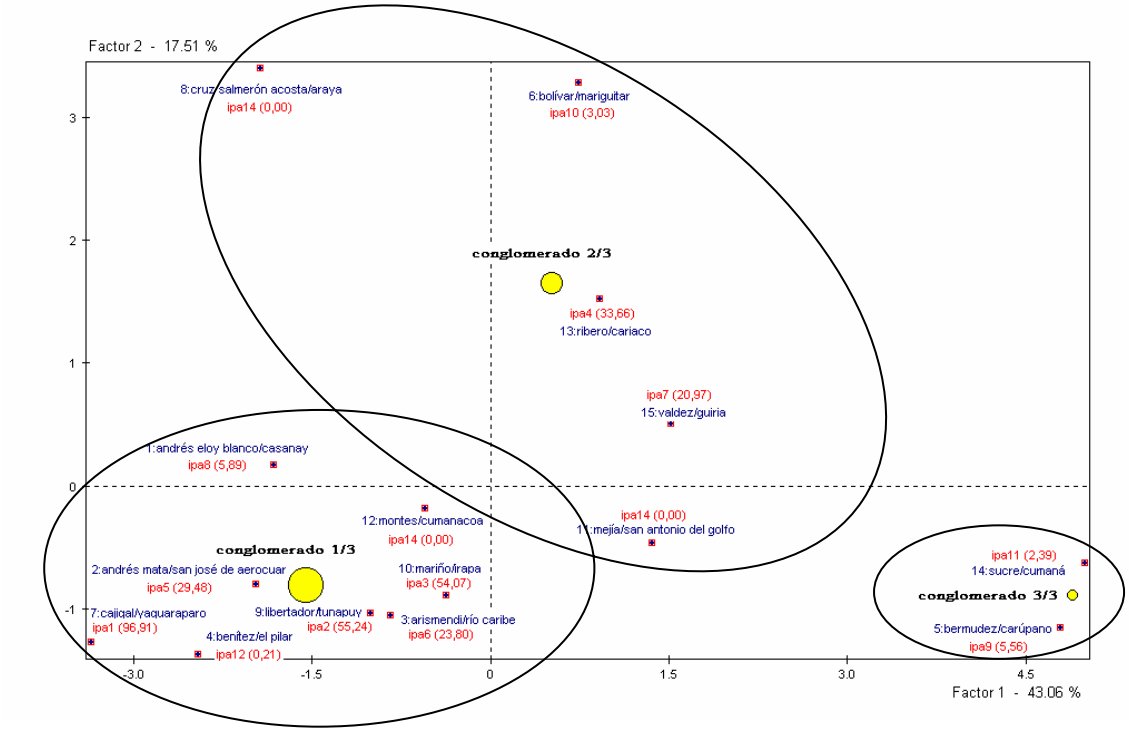

Figure 9. State of Sucre 1999- Hierarchical Diagram

Socioeconomic index data and particularly those derived of employment and agricultural activities reveal that Paria region has high values of them.

Other important indexes like rural population and low socioeconomic potential (INE, 1999) pinpoint that only primary activities with very low technological and low productivity levels are associated to this region

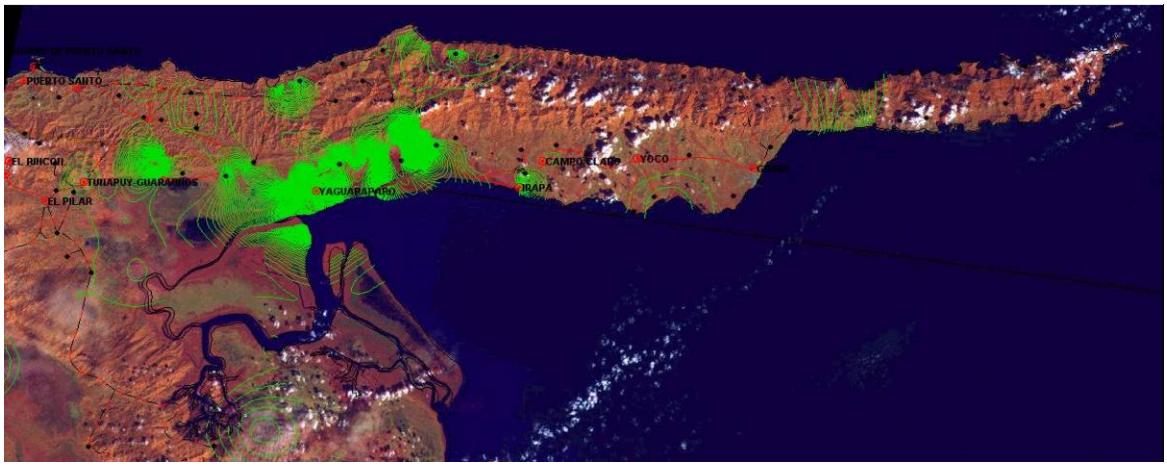

Figure 10. Image 153 TM5, band combination 4,5,3 and The Malaria Spatial Incidence Model 1990

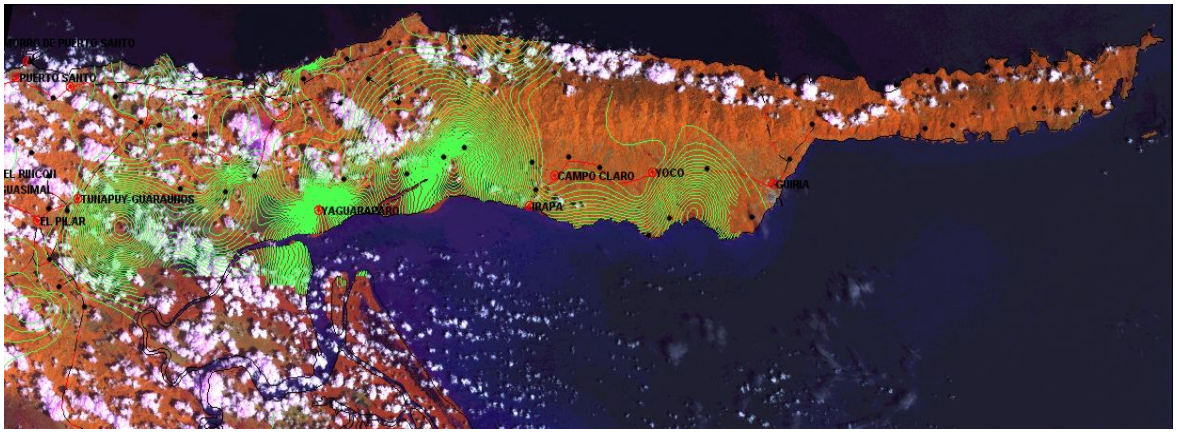

Figure 11. Image 153 TM7+, band combination 4,5,3 and the Malaria Spatial Incidence Model 1999

Spatial analysis conducted between the malaria disease incidences during the year 1990 on top of the TM5 153 image from December of the same year shows a strong relationship between places with major malaria intensity, or malaria focus, located at the low land zones with no intensity data for the year 1999, where also is observed the increase of the focus of malaria which means a more severe incidence of the disease in those zones

When results coming from spatial analysis were combined with the information regarding land uses and the degree of land intervention by the man, the product reinforced the found relation and makes it consistent with the founds from other authors in related research works. Moreover, the relation was definitively established trough the statistical analysis when Principal Component and Hierarchical Analysis were conducted on the data collected. (See figures 7, 8, 9 for results of them).

Lower land areas are strongly impacted and fragmented (Delgado *et al*. 2003a, 2003b, 2003c) but also they are the most socioeconomic depressed. The fact that agricultural activity is the predominant there, conducts to consider the major causes favoring persistence of malaria within the ecological system functioning (Kitron and Spielman, 1998, significant slopes, and also with a high agricultural activity among land use modalities. A similar response was observed when the same process was conducted on the respective combination of the image TM7+ 153 and malaria

Gunawardena *et al.* 1998, Keating *et al.* 2003, Klinkerberg *et al.* 2004):

- Abandoned land from agriculture and land irrigation techniques used
- Human population displacement in search for job opportunities and better living conditions
- Local clime alteration as consequence of changes due to land uses and their impact on the natural systems

All of them are contribute to increase the risk of Malaria disease and to promote habitat transformations which rapidly were colonized by the vector to populate them, transforming the region in an endemic one for malaria

Conclusions

Natural and socioeconomic variables are tightly related, both of them must be considered at once to develop valid models reproducing dynamic of metaxenic diseases.

From this perspective, malaria represents a subsystem nested within the ecological system modified by man action to establish the human socioeconomic rural population regime in the region.

Both, changes in the system due to low technological input in the agriculture activity and man made modifications on the system favored the mosquito vector of malaria to colonize new places increasing its habitats and so, more stable populations to transmit the disease.

Spatial heterogeneity resulted as a key variable to be considered in structuring and implanting public health control plans and policies

Those plans and policies must consider local features like agricultural activity and change in land use, etc. to make them real effectives

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Satellite-Based Early Warning Systems to Predict and Alert on the Risk of Waterborne Disease Outbreaks

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SUMMARY

A great deal of information on environmental and climatic factors involved in triggering infectious disease outbreaks has been obtained in studying auchthoctonous microorganisms which have their natural habitat in marine/freshwaters such as *Vibrio cholera*. *Vibrios* can adhere to algae and zooplankton and in this way they can survive and spread in the ocean. The increase in sea surface temperature (SST) and other environmental and climatic changes favour an anomalous multiplication of plankton and consequently of bacteria adhered: concentrated vibrios can more easily infect humans. Recently two large *Vibrio parahaemolyticus* epidemic have been described in the South of Chile causing a number of severe cases of disease and important economical consequences. By using information provided by satellites it has been possible to establish a relationship between sea surface temperature and algal anomalous proliferation in the Chilean marine environment. This relationship would be the basis to set up an satellite-based Early Warning System (EWS) to predict increasing numbers of plankton-adhered vibrios and prevent the risk of consequent disease outbreaks.

INTRODUCTION

Waterborne (WB) and other infectious diseases represent currently an important threat for human health because of the emergence of new microbial species and strains, the changes in the immunological state of the population (immunocompromised, aged people) and the pressures caused by increasing population and climatic changes among other reasons. During last years it has been observed a decrease in the microbiological quality of water and an increase in waterborne disease (WBD) outbreaks worldwide.

There is mounting evidence that some environmental and climatic factors are involved in triggering infectious disease outbreaks: for example, increased water temperature favours multiplication of microbial agents, extreme rainfall causes excessive runoff and washing of material of fecal origin into potable water and extreme weather events can impair local sewage systems and cause contamination of water systems. On the basis of these data some infectious diseases are currently considered as "climate sensitive" including also waterborne diseases (cholera, salmonellosis)[1].

A great deal of information on WB pathogens and environmental factors derives from studies on auchthoctonous microorganisms which have their natural habitat in marine/freshwaters such as *Vibrio cholera*. *Vibrios* can adhere to algae and zooplankton and in this way they can survive and spread in the ocean. The increase in sea surface temperature (SST) and other environmental and climatic changes favour an anomalous multiplication of plankton and consequently of bacteria adhered: concentrated vibrios can more easily infect humans. For this reason adhesion of bacteria to plankton represent a survival strategy allowing *Vibrios* to persist in an adverse environment like marine waters[2].

With a changing climate, environmental conditions affect both the overall abundance and, potentially, the serogroup of *V. cholerae*. Moreover, the geographic range of *V. cholerae*, *V. parahaemolyticus* and *V. vulnificus* may also change (changes in salinity for example) resulting in increased exposure and risk of infection for humans. Also changes in plankton population and other hosts (bivalve shellfish, terrestial and aquatic animals) would alter the ecology of these pathogens.

To predict and prevent waterborne disease outbreaks it could be very useful to rely in an Early Warning System (EWS) revealing any alarming data or trend change in the climatic/environmental factors influencing the presence and persistence of WB pathogens. Usually, EWS are based on telephonic and telematic communication networks and on epidemiologic data but the application of space technologies to EWS is currently object of increasing consideration: only satellite-based EWS could predict infectious disease outbreaks within times compatible with the preparation of an adequate response[3]. Moreover, the permanent monitoring of the environmental factors by earth

observing and meteorological satellites would facilitate the construction of growing databases which, integrated with clinical and epidemiological data, could be useful in setting up more efficient EWS and in creating predictive models: the development of a growing database will provide future generations with increasingly accurate predictability. Finally, satellites provide large coverage, including isolated, remote areas, which would otherwise not be monitored, and allow equal access to any population[3].

OBJECTIVES

To evaluate the possibility of developing an EWS based on the use of satellite-provided data regarding phytoplankton blooms and specific ocean parameters in order to predict and prevent the risk of environment-related infectious diseases and economical losses in aquaculture of shellfish and fish exploitation areas.

MATERIALS AND METHODS

Satellite products derived primarily from MERIS and AATSR instruments aboard the ESA ENVISAT spacecraft has been used together with *in-situ* observations. Data from the MODIS instrument aboard NASA TERRA and AQUA satellites have been also integrated.
ENVISAT data has been analysed using the software BEAM developed by ESA and MODIS data has been processed using SeaDAS distributed by NASA. Satellite data were obtained in Level 1 and level 2.
Isolation from water and faecal samples and identification of *Vibrio parahaemolyticus* was performed using standard methods[4].
Epidemiological data on the number of persons affected by the disease (infection by *V. parahaemolyticus* was suspected if patients had watery diarrhoea and had eaten raw or undercooked seafood, especially shellfish) were obtained from Ministry of Health.

RESULTS

Several satellite oceanography applications have been carried out in the southern region of Chile[5] and among these, coastal monitoring activities related to human poisoning due to consumption of seafood affected by harmful algae or bacteria as *Vibrio parahaemolyticus*[6].

During the year 2002, an outbreak of the species *Alexandrium catenella*, host of Paralytic Shellfish Poisoning (PSP), has been detected in south of Chile and was responsible of 73 human intoxication cases and two deaths. The outbreak affected that area of the country where shellfish exploitation represent the 60% of the total amount destined to international markets. The region of 43ºS was closed for shellfish extraction between the years 2002 and 2004.

On the basis of previously proposed links between environmental parameters, quantity of phytoplankton, concentration of zooplankton-adhered vibrios and risk for human health[2], data from the SeaWiFS instrument, on board SeaStar, and Near Real Time data from ENVISAT, Terra and Aqua satellites were used to demonstrate the feasibility of using ocean colour remote sensing to follow microalgae bloom. These events could represent a health risk for the population in that algae carried any harmful toxin. The algae bloom can also be harmful for the aquaculture industry as they produced suffocation of fishes in the cages or other negative effects.

Since 2003, some bacterial species have been detected for the first time in waters of the region and one of them was identified as *Vibrio parahaemolyticus*. The isolated strain was responsible for more than 1.500 intoxication human cases during the 2004 austral summer.
It has been demonstrated[2] that increased water temperature and other environmental parameters accelerate the vibrios growth rate and favour their concentration on plankton thus increasing the risk for human health. Using the remote instrument AATSR aboard ENVISAT satellite and ancillary data, main areas for seafood resources at risk for being infected with bacteria were determined helping local health authorities to define areas at high risk of intoxication and avoiding the closure of low-risk areas.

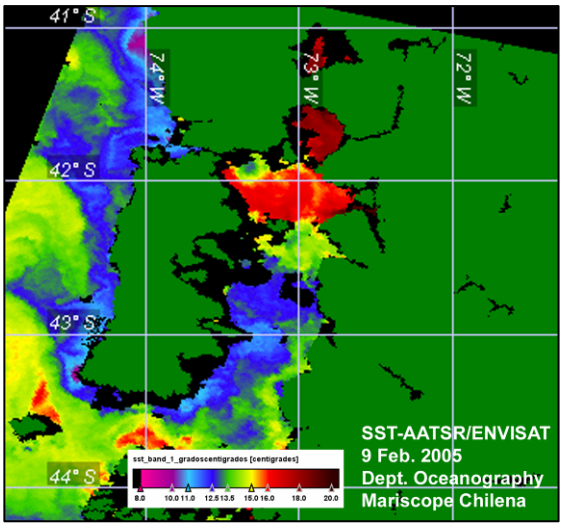

***Figure 1**: Sea Surface Temperature (SST) from the European Environmental Satellite ENVISAT. The data where obtained through a scientific project of the Earth Observation section of ESA.*

During summer of 2005 the preventive actions did not include sanitary barriers, nor restrictions on the shellfish extraction and this led to an countrywide epidemic with more than 10.000 intoxication cases and one human death.

In Figure 2 is presented the temporal evolution of intoxication cases during the *V. parahaemolyticus* outbreak of the summer 2005. As it is shown, using remote sensing it is possible to anticipate up to 6 days detection of the first bacterial disease cases.

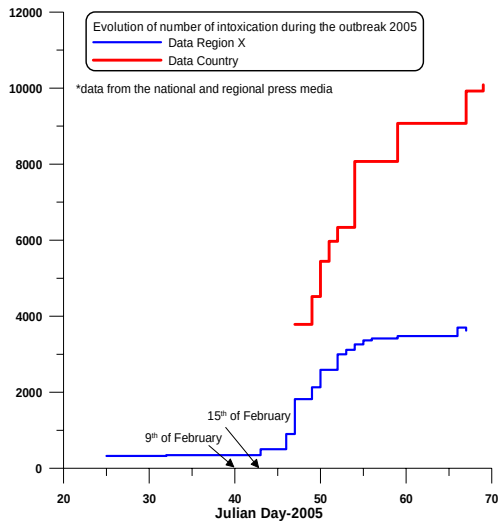

***Figure 2**: Temporal evolution of intoxication caused by Vibrio parahaemolyticus in Chile during the outbreak of 2005.*

CONCLUSSIONS

The results presented in this study are part of the first ENVISAT data application in Chile, mainly focused on early warning for prevention of human health risks in an economically interesting area for shellfish exploitation.
Shellfish can concentrated in their bodies, which are sources of food for human use, bacteria or toxins present in waters. The presence of some harmful organisms such as *Vibrio parahaemolyticus* is considered a justified reason to close the extraction during critical periods, as indicated by the European Community in 2001[8]. However, to be able to prevent the total closure exploitation activity in the region and to restrict the areas of risk for human health would avoid unnecessary negative economical repercussions. Extraction prohibition of marine resources implies a considerable economic crisis, such as the one experienced after the summer of 2002, when an algal bloom caused by the toxic species *Alexandrium catenella*, caused 73 cases of human intoxication and obliged the Government of Chile to declare the state of catastrophic area. For this reason the exclusion of risk-free areas is considered of great social impact.

Moreover, satellite data can help to monitor extended areas and to plan the *in situ* measurements.
The setting up of an Early Warning System must rely on biological basis relating environmental/climate factors with persistence and diffusion of bacteria present in waters: only in this way detection of significant modifications of those specific parameters would allow the prediction of increased risks to human health linked to higher concentration of infectious agents in the environment. With an efficient EWS, the exploitation of the shellfish resources could be blocked only where and when increases in SST are detected by remote sensing. Thus, the emergence of algae blooms can be detected (by measuring ocean colour via satellite and ancillary *in situ* data) several weeks before the increase of the level of toxins or bacteria concentration in shellfish and therefore before detection of human intoxication cases[9].

The possibility of using data from satellites would allow to early detect changes in environmental/climatic parameters favoring the development of algae blooms and/or increases in plankton-adhered bacteria in time to carry out mitigation procedures. Moreover, integration of these data with microbial, veterinarian and field data would facilitate preparation of maps of risk areas for the emergence of environment-related diseases.

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Remote Sensing –GIS to Predict on the Risk of Eutrophication in Aquatic Systems

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Abstract-Lakes and dams are exposed to environmental degradation, and the low renovation time of some of them, makes them vulnerable to pollution as a result of anthropic impacts. Main objectives of this work were the prediction of water quality for different uses, and the evaluation of eutrophication in dams of central Argentina, by means of physico-chemical, biological and phycological analysis, integrating remote sensing and GIS in order to asses potential risks for animal and public health. The first (Río Tercero, 64º 23'W y 32º 10'S; 4600 ha) and the last (Piedras Moras 32º 12'S, 64º 19'W; 832 ha) dams in the basin of Ctalamochita or Tercero River were studied. Both are used as reservoirs for drinking water, hydraulic engeneering, irrigation, recreational and sports activities. Seasonal samplings were performed during three consecutive years in both sites. Parameters were evaluated in situ and in the laboratory, according to standard methodology. For Rio Tercero dam, water characteristics were those corresponding to freshwater, calcium bicarbonated. Trophyc status was mesotrophyc. Phycological counting showed that, during summer, *Bacillariophyceae* were dominating over *Cyanophyceae*. The studies integrating sensors, GIS and Landsat 5TM images to determine spatial variability of chlorophyll-a showed a higher concentration at the affluents during spring time. For Piedras Moras dam, the aplications of Surfer for Windows, Idrisi and Variowin were used, integrating in a GIS the experimental information together with the one obtained by means of digital processing of Landsat 5TM images. The aplication of spatial interpolation techniques -kriging- determined that dispersion of total nitrogen was different according to the season. Total phosphorous at spring showed its higher levels at Soconcho River and Balneario stations. Maximal levels of chlorophyll-a were observed in spring at those stations corresponding to affluents and recreational areas. The studied dams are situated between the guidelines proposed by actual legislation. Risks of bloomings could happen all over the year, diminishing during fall season. According to the importance of these systems, it is necesary not only the performing of monitorings to evaluate and protect these reservoirs, but also to establish an integral program of strategies for the prospective management of dams in order to determine risky areas and early warning systems to protect health. **Keywords: Water quality, remote sensing, eutrophication, public health**

INTRODUCTION

Argentina has a wide territorial extension of about 2.700.000 km^2. Lakes and dams are exposed to environmental degradation, and the low renovation time of some of them, makes them vulnerable to pollution as a result of anthropic impacts.

The excess of organic matter modifies the natural chemical composition of the water, with an increase in primary production [1] [2]. When high levels of eutrophication are reached, algae are among the best bioindicators of pollution and some of their blooms may be hazardous both for animal or human consumption.

OBJECTIVES

Main goals of this work were the prediction of water quality for different uses, and the evaluation of eutrophication in reservoirs of central Argentina, by means of physico-chemical, biological and phycological analysis, integrating remote sensing and GIS in order to asses potential risks for animal and public health.

MATERIALS AND METHODS

The first (Río Tercero, 64º 23'W y 32º 10'S; 4600 ha) and the last (Piedras Moras 32º 12'S, 64º 19'O; 832 ha) reservoirs in the basin of Ctalamochita or Tercero River were studied. Seasonal samplings were performed during three consecutive years in both sites.

The lakes are used as reservoirs for drinking water, hydraulic engeneering, irrigation, recreational and sports activities. Seasonal samplings were performed during three consecutive years in both sites. Parameters were evaluated in situ and in the laboratory, according to standard methodology. The first has 46 km^2, with a maximum of 560 hm^3 and a production of 58000 Mwh/a. Piedras Moras dam has 832 km^2, with 90 hm^3 and 46000 Mwh/a.

For fisico chemical analysis the samples were collected at 20 cm depth and the parameters evaluated were smell, turbidity, colour, temperature, pH, dissolved oxigen, conductivity, clorines, sulfates, bicarbonates, alcalinity, arsenic, BOD, COD, total nitrogen and total phosphorus [3].

For algal study the samples were collected in the same way, fixed in formaline 3%. The identification of the organisms was made under optic microscopy, by means of identification keys and direct counting was expresed as cells in 25 ml. Chlorophyll a was measured by photocolorimetry [4].

Mapping chlorophyll a and nutrient

In this study a GIS package (Envi ver. 3.5) has been used. Water samples were collected from various inside the Rio Tercero reservoir. To accurately mark the location of sampling station inside the lake a GPS was used.

The chlorophyll model was applied on the band 2 and the band 4 image of the lake [5] [6] [7]. For Piedras Moras reservoir, the aplications of Surfer for Windows, Idrisi and Variowin were used, integrating in a GIS the experimental information together with the one obtained by means of digital processing of Landsat 5TM images.

RESULTS

For Rio Tercero dam, water characteristics were those corresponding to freshwater, calcium bicarbonated.

According to this results Rio Tercero dam was mesotrophic. Piedras Moras dam was eutrophic to hipertrophic (Table I and Table II).

TABLE I
LEVELS OF NT, PT, N:P AND CHL A. SUMMER. RIO TERCERO.

Parameters	Unit	Sampling stations*					
		1	2	3	4	5	6
Secchi disk	(m)	0.55	2.15	2.9	2.45	3.1	0.7
Total nitrogen	(mg/l)	0.7	0.6	0.6	0.6	0.6	0.6
Total phosphorus	(mg/l)	0.02	0.02	0.02	0.02	0.02	0.02
N:P	(mg/l)	35	30	30	30	30	30
Chl a	(µg/l)	31	14	9	5	7	6

*Average value

TABLE II
ALGAL DISTRIBUTION IN RÍO TERCERO DAM. SPRING (nº cells/25 µl).

	SAMPLING STATIONS						
	1	2	3	4	5	6	7
Cyanophyceae							
Microcystis aeruginosa	-	-	1	2	-	-	-
Anabaena spiroides	-	2	-	1	-	-	-
Lyngbya aerugineo-coerulea	1	12	1	-	-	-	-
Phormidium uncinatum	-	-	-	-	-	-	1
Chroococcus	3	-	30	1	10	-	24
Merismopedia sp.	-	1	-	-	-	-	-
Bacillaroficeae							
Melosira granulata	-	14	8	25	17	-	5
Cyclotella sp.	2	-	-	23	19	-	10
Otras	50	32	41	30	29	-	13
Euglenoficeae							
Euglena sp.	-	26	23	-	-	-	1
Zygoficeae							
Cosmarium sp.	-	1	-	-	-	-	-
Chlorophyceae							
Pediastrum duplex	-	-	1	-	1	-	-
Selenastrum sp.	-	-	-	-	1	-	-

1. Quillinzo river and La Cruz river
2. Cooling channel
3. Centre of the lake
4. Villa Rumipal beach
5. Hotels
6. Villa del Dique entrance
7. Dam

- Absence in the sample
Average values

The studies integrating sensors, GIS and Landsat 5TM images to determine spatial variability of chlorophyll-a showed a higher concentration at the affluents during spring time (Table III).

TABLE III
LEVELS OF THE CHL A CONCENTRATION AND REFLECTANCE IN BAND 2 (R2). RÍO TERCERO DAM.

Sampling stations	1	2		4	5	6	7
Chl a (µg/l)	31	14	9	5	7	4	6
R2	70.046	65.495	64.157	63.086	63.622	62.818	67.747

For Piedras Moras reservoir, the aplication of spatial interpolation techniques -kriging- determined that dispersion of total nitrogen was different according to the season. Total phosphorous at spring showed its higher levels at Soconcho River and Balneario stations [8]. The dominating species in summer were *Microcystis aeruginosa*, *Spirulina platensis* and several genera belonging to the *Bacillariophyceae*, with concentrations of 83.8, 149.4 and 15 cells/25 µ l respectively.

Maximal levels of chlorophyll a were observed in spring at those stations corresponding to affluents and recreational areas.

The areas showing high concentration of chlorophyll a are the areas which are receiving untreated sewage, nutrient and pollutant load. In Rio Tercero dam, the chlorophyll a was highly correlated with transformed spectral features of the Landsat TM data, particulary TM2 y TM4 (Fig. 1).

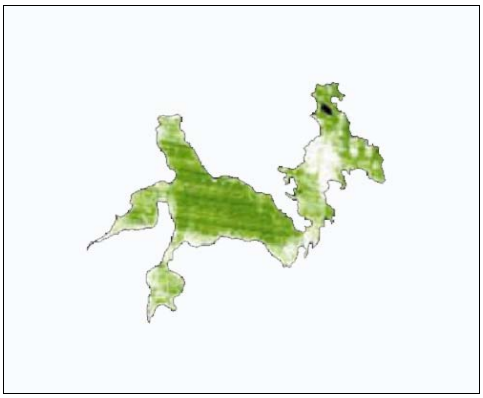

Figure 1. Chlorophyll a distribution in Rio Tercero reservoir. Landsat 5TM. CONAE. 2005.

Risk on health and environmental

According to results, the higer risk of blooms productions happens durings the whole year, except in the fall [9]. Río Tercero and Piedras Moras reservoirs presented a low risk of toxins.

CONCLUSIONS

The studied dams are situated between the guidelines proposed by actual legislation. Risks of bloomings could happen all over the year, diminishing during fall season. Being Piedras Moras the last reservoir in a row of several ones, its situations is advantageous because the other reservoirs retain phosphates and some other nutrients. This preliminary results demonstrate the potential of combining usage of TM data and geoestatistical modeling for probabilistic evaluation of environmental topics.

According to the importance of these systems, it is necesary not only the performing of monitorings to evaluate and protect these reservoirs, but also to establish an integral program of strategies for the prospective management of reservoirs in order to determine risky areas and early warning systems to protect health.

ACKNOWLEDGMENTS

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Satellite Image Applied to Epidemiology, the Experience of the Gulich Institute in Argentina

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Abstract. The advances in the quantity and quality of Space information and the continuous growth of epidemiological problematic have given major impetuses to Landscape Epidemiology. In this frame, since 2001, Argentine Space Agency (CONAE) and National Health Minister (MSN) started working together to develop new tools for epidemiological surveillance, based on Space Information. In this work we present some examples of this activities developed in the Space Studies Institute "Mario Gulich".

I. INTRODUCTION

Argentine can be define as a "Space Country". That means that Space Information is vital for Argenine socio-economic development. In this context, the National Space Agency (CONAE) is making great efforts to offer space information to all the socioeconomic sectors of our country and to generate human resources capable to use it. An initiative in this direction is the Institute on Space Studies "Mario Gulich. Conceived as a non-centralized organization, initially devoted to offer graduate workshops and courses in basic space technology and its applications. The main goal of these activities is the generation of Early Warning Systems on environmental emergencies using space information. In the concept of "environmental" we explicitly include the Applications of Satellite Images to Epidemiology.

The application of space information to health, particularly the so called "Landscape Epidemiology", is a relatively new interdisciplinary approach that involves the characterization of eco-geographical areas where diseases develop. Landscape Epidemiology can be understood as a part of a second-generation of applications of remotely sensed data, where the target (the vector or reservoir of a decease) can not be detected directly in satellite images. It is a holistic approach which takes into account the relationships and interactions between different elements of ecosystems under the assumption that the biological dynamics of both, host and vector population, are affected by landscape elements such as temperature and vegetation [1], [2] , [3], [4].

Here, we present some specific experiences of this discipline developed in Argentina applied to vector and rodent-born diseases. As a first example, we present some results of rodent population dynamics numerical model and Junin virus infection, (etiologic agent of Argentine hemorrhagic fever, in its host, *Calomys musculinus)*. In contrast to the usual statistical approach, the model incorporates satellite-derived environmental data in a causal approach. In a second case, we present a study on the geographical distribution of three rodent species with epidemiological relevance (Hantavirus and Argentine Hemorrhagic fever hosts). It is based on historical vegetation and temperature data derived from NOAA satellite imagery series, including also precipitation and elevation data. Finally, we show preliminary results of Dengue research, in particular of the temporal evolution modeling of Breteau and Aedes aegypti house Infestation Indexes observed in an endemo-epidemic zone during 1998 – 2003 period.

II. RODENT BORNE DISEASE A)

Argentine Hemorrhagic Fever (AHF) is a rodent-borne viral infectious disease that occurs in central Argentina humid pampas. The etiologic agent is Junin virus (JUNV), a member of the *Arenaviridae* family. AHF is a severe systemic disease with hemorrhagic and neurological manifestations. The first cases were recognized in Buenos Aires province in the 1950´s, when the disease was limited to an area of 16,000 km^2. The endemo-epidemic region has spread to Córdoba, Santa Fe and La Pampa provinces, covering nowadays an area of 150,000 km^2 . The incidence of AHF varies among geographic areas among seasons, and from year to year. JUNV is naturally maintained and spread by its reservoir the dry lands vesper mouse, *Calomys musculinus*. Known reservoir distribution includes central and northwestern Argentina, (an area much larger than endemic area of AHF). JUNV infection is highly focal in *C. musculinus* and varies among localities, seasons, and years. The virus maintenance in nature occurs principally by horizontal transmission between adult males. The principal human infection mechanism is by inhalation of infectious aerosolized particles

of rodent excreta. Other potential routes of entry include direct contact with mucous membranes or broken skin, or ingestion .

This Project is developed in the frame of the agreements between the National Health Minister and CONAE with the objective of building of a causal model of population dynamic and viral transmission, using environmental conditions sensed by satellite as input, to estimate disease incidence and simulate different environmental scenarios.

The model assumes the existence of two sub-populations, "X" representing the non-infected rodents and "Y" the infected rodents. Both "X" and "Y", are expressed as a fraction of the ecosystem species carrying capacity. The temporal equation for the non-infected and infected rodents are:

$$\frac{dX}{dt} = \alpha(1-N)X - \beta XY - \frac{X}{\tau}$$

$$\frac{dY}{dt} = \beta XY - \frac{Y}{\tau m}$$

X = Non-infected host population as a fraction of carrying capacity. **Y** = Persistently infected host population as a fraction of carrying capacity.**N** = Total *C. musculinus* population.. τ (tau) = maximum "mean life span". .α (alpha) = potential (per capita) reproductive rate in absence of carrying capacity constrains. β (beta) = average number of non-infected hosts that an infected host can infect during its lifetime. The term β XY is the infection rate. **m** = accounts for differential mortality rate. Parameters for *C. musculinus* were extracted from our database and from the literature.

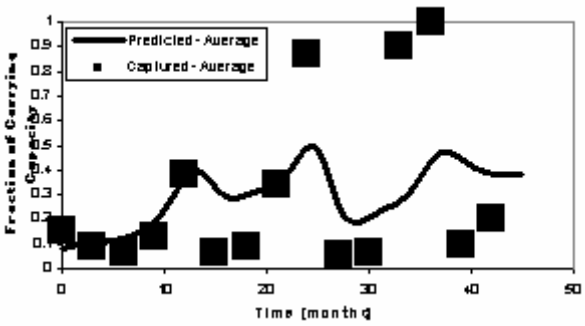

Figure 1. Normalized measured total population density and the simulated

As our goal is to develop an alternative method to characterize rodent-borne diseases related parameters, we are interested in identifying those parameters associated with environmental conditions that can be monitored using remote sensors. We selected NDVI derived from the AVHRR instrument, on board the NOAA satellite, as a remotely sensed variable representative of environmental condition. NDVI was chosen because this greenness index integrates environmental information such as temperature and precipitation, that influence host populations biological parameters and, indirectly, measures habitat variables such as the quantity and quality of refuge and food. We assumed a linear dependence of reproductive rate "α" and mean life span "τ" on NOAA AVHRR NDVI data. So, when NDVI increases (summer) we propose "α" and "τ" take their maximum values, and when NDVI has lower values (winter) we assume, based on experimental evidence, that birth rate decreases and mortality increases ("α" and "τ" decrease).

The study area included parts of the Argentinean humid pampas, in southern Santa Fe and northern Buenos Aires provinces. This region includes the AHF-endemic area, and the large quantity of historical field and epidemiologic data available (last 25 years), which gives us a strong cognitive base in order to contrast the model results.

We attempted to evaluate the capability of our model, to describe the temporal and spatial variations of rodent populations monitored at several localities in the study area during 1991-1994. For each locality, the model was run using the corresponding pixel values of NDVI from NOAA decadal imagery during the simulation period. Field data are presented as total relative population densities derived from standardized trap success. Figure 1 presents total population density normalized measured and simulated population density (X+Y+Z) averaged for three localities: Máximo Paz, Alcorta and Pergamino. Figure 2 includes measured and simulated data for each locality.

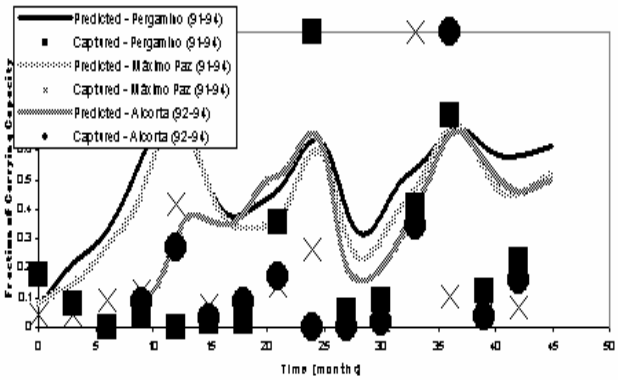

Figure 2. Measured and simulated data for each locality.

A complete description of this model can be find in [5].

III. RODENT BORNE DISEASE B)

In this second example, we model potential distribution of three zoonosis reservoir rodents: *Calomys musculinus*, *Oligoryzomys flavescens* and *O. longicaudatus (hosts of Argentinean Hemorragic Fever and Hantavirus pulmonary syndrome)*. These provide general distribution hypotheses using environmental data of sites where the species were registered. Remote sensing data from climatic and ecological features satellite was used to identify particular environments suitable for these rodents. The three species predictive maps registered high overall accuracy.

The maps obtained (fig 3) here afford several advantages. First, the predictive maps incorporate geographically explicit

predictions of potential distribution into the test. (In comparison to other prediction models of species distribution For instance: GARP, FloraMap, BioMap, etc) Second, the validity of the predictive map can be appreciated when localities of previous records of the studied species, not used as training sites or used as control sites, overlay in the map. In this approach, environmental factors, criterion and analytical techniques are explicit and can be easily verified. Hence, we can temporally fit data in more precise distribution maps.

In order to evaluate the potential distribution range of the sigmodontine rodents *C. musculinus, O. flavescens* and *O. longicaudatus,* we used geographic computer databases on spatial distribution of environmental factors including the following data:

Precipitation: A latitude-longitude rasterized grid of a 30-years-monthly mean rainfall having a spatial resolution of 30 min (Leemans and Cramer, 1991; Cramer and Leemans, 2001). IIASA database, Luxemburg, Austria. Available from http://www.daac.ornl.gov

Vegetation Index: A 1982-1992 time serie of Normalized Difference Vegetation Index (NDVI) from meteorological satellite of National Oceanic and Atmosphere Administration / Advanced Very High Resolution Radiometer (NOAA/AVHRR) with a pixel of 8 x 8 km. NDVI=(Ch2-Ch1)/(Ch2+Ch1), Ch is the channel of AVHRR sensor.

The Land Surface Temperature (LST) of the former temporal series LST= Ch4+3.33(Ch4-Ch5) (Price, 1984), and

Digital Elevation Model (DEM): 1 km x 1 km of spatial resolution data from AVHRR sensor, provided by USGS, 1998. Eros Data Center. Available from http://edcdaac.usgs.gov/gtopo30/gtopo30.asp

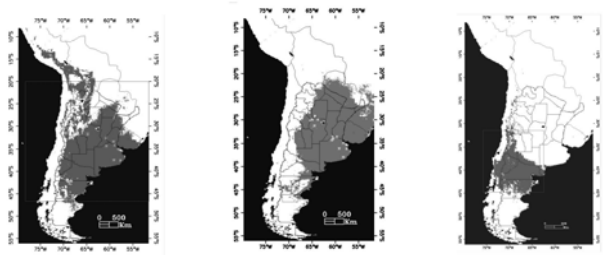

Figure 3. Geographical distribution obtained for *C. musculinus, O. flavescens* and *O. longicaudatus respectively*

A complete description of this modelling can be find In [6].

IV. Dengue Fever

Dengue fever(DF) and Hemorrhagic Dengue fever (DHF) have become the main problems of health in tropical and subtropical countries where the main vector has expanded, mainly in susceptible populations of urban areas with demographic expansion, affecting populations in extreme poverty. The four known virus serotypes (DEN-1, DEN-2, DEN-3, DEN-4) are transmitted by *Aedes* mosquitos (*aegypti, albopictus, polynesiensis* and *scutelaris*); the circulation of more than one serotype in a place implies the possibility of occurrence of DHF, a severe form of the disease. The DHF mainly affects children and young adults; between the symptoms there are an acute and pronounces sudden fever, haemorrrhagic fenomena, often with hepatomegaly and, in severe cases, signs of circulatory failure. Such patients may develop hypovolaemic shock resulting from plasma leakage called dengue shock syndrome [7]. In Argentina, the recognized vector is *Ae. aegypti*, a cosmopolitan, highly anthropophilic specie that thrives in close proximity to humans and often lives indoors. It is developed in an ample variety of deposits; the females feed themselves by day and have preference by the human blood [8]. In Argentina the Dengue virus reappears in 1997 [9], and at the moment there were Dengue cases in Salta, Jujuy, Formosa, Misiones, Buenos Aires and Cordoba provinces. Nevertheless, Salta was the most affected province (Ministry of Health). Studies made at Salta, Buenos Aires and Cordoba city [10], to consider the abundance of *Ae. aegypti*, indicated a certain situation of dengue outbreak risk.

Approximately 5% of DHF cases are fatal and DF affects about 2.5 million people in more than 100 countries in tropical and subtropical zones, since it is considered the most important viral disease transmitted by arthropods [8]. At the moment, vector strategic control is the most reasonable solution to prevent Dengue Fever in countries like Argentina, that present indigenous transmission regions and cases introduction from bordering countries, and above all, considering the non-existence of a vaccine or specific treatment available [8]. For that reason, it is necessary to previously develop an efficient early prediction system of vector distribution and abundance.

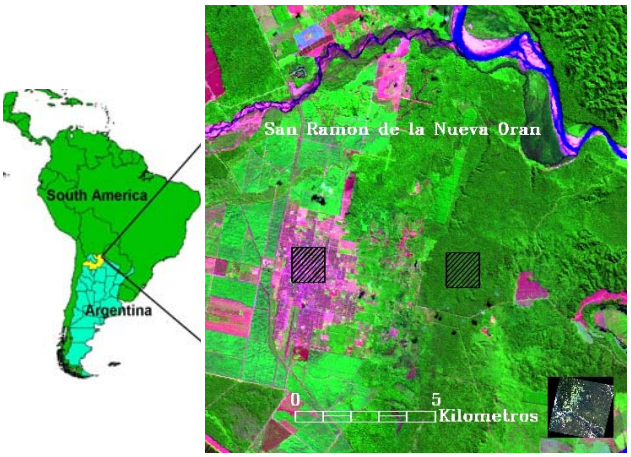

Figure 4:. Geographical localization of ORAN

The House index (HI) and Breteau index (BI) also known as Aedic indexes, are entomologic indexes that can be used in studies for the prevention and control of DF and DHF.

$$\textbf{Breteau index} = \frac{\text{Number of infested containers}}{\text{Number of inspected houses}}$$

$$\textbf{House Index} = \frac{\text{Number of infested houses}}{\text{Number of inspected houses}} \times 100$$

The aim of this work is to construct predictive statistical models of temporary variations of observed House (HI) and Breteau (BI) aedic index, of at least 3 years period, for Tartagal and San Ramon de la Nueva Orán cities. Both are located in the base of the Andean mountain region, in Salta Province, at 55 and 45 km from south Bolivian respectively. The figure 4, present the geographic localization of ORAN.

The "multivariate regression" statistical models, were based on the following preexisting data: a) Aedic Indexes (HI and BI), b) vector intervention and c) control activities, provided by the National Coordination of Vector Control, National Health Minister, Argentina; d) precipitations; e) Land Surface Temperature (LST) and f) vegetation (NDVI), both derived from Landsat 5 TM and Landsat 7 ETM image series, from two representative subsets (40X40 pixels) of city and native forest (figure 4).

In this way A set of 8 independent variables were obtained: Average and Variance of the temperature for the "city square" and the "forest square", average and variance of the NDVI (for the city and the forest), as well as the precipitation.

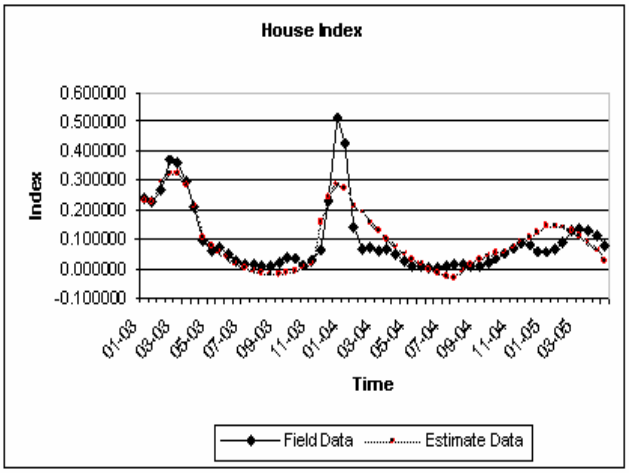

Figure 5. House index measured and modeled

The modeled curves with data of Tartagal have a positive correlation in the range of 0,80 with BI and 0,90 with HI. When using only half of the field data as training set (1998-2000) the results of the model have a prediction for the subsequent year on around 80% for both indexes. For Oran city, the values thrown by the model present a positive correlation in the range of 0,80 for both indexes.

Using the STATISTICA software we have perform a Forward Step-wise multiple regression analysis. For the House index (fig. 5) the correlation was 0.876 and the variables included in the model were: mean city NDVI, forest mean NDVI, forest temperature variance, city temperature variance, forest temperature mean and city temperature mean respectively. Breteau index Correlation was 0.828 (fig.6), and the variables included in the model were: city NDVI mean, forest mean temperature, city mean temperature, city NDVI variance and forest temperature variance. Both indexes p values were statistically significant (value < 0.05 level).

This demonstrates the possibility of using space information in operative way, for the estimation and prediction of epidemic relevance vector indexes.

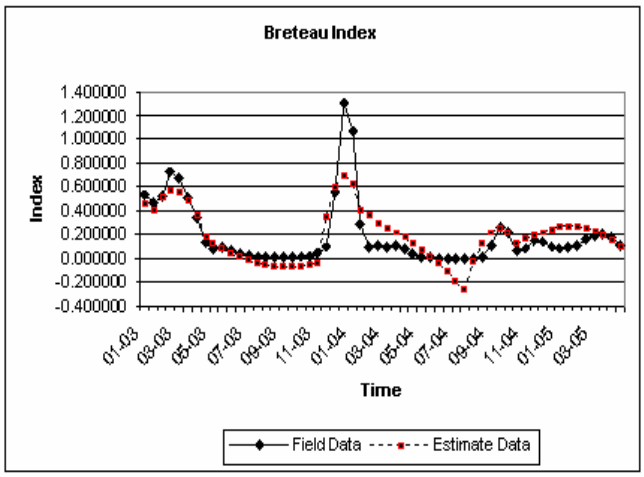

Figure 6. Bretau index measured and modeled

ACKNOWLEDGMENT

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Part of this work is also in the frame of international cooperation Program "MATE", developed with the French consortium S2E (surveillance Espatiale des Epidemies).

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Session 13

Making Better Healthcare Service Best: Healthcare Challenges

Towards A Global E-Health Framework for the Support of Pandemic Control

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Recent occurrences of epidemics like the Severe Acute Respiratory Syndrome' (SARS) in 2003 or, the 'Avian Influenza' in 2005 clearly display the threat and seriousness of global diseases. The steadily growing globalization makes it difficult to contain epidemics to a certain region. Hence they are called Pandemics. Furthermore, global disease threats are not limited to natural causes anymore. The possibility of terrorists using biological weapons has become very real. Although many countries are now working on their own security frameworks, a global problem of this magnitude requires a global solution. For these reasons, a global framework must be designed and implemented. This paper reviews the current efforts in evolving a global solution to the problem, and summarizes the basic principles of such a framework for pandemic control.

Three major organizations working on this topic are WHO, European Centre for Prevention and Disease Control (ECDC) and Centres for Disease Control and Prevention (CDC) . They have established and maintained numerous networks for different purposes. These organizations and even some of their networks cover several topic areas. There are a number of specialized content and application networks for disease surveillance and control, such as:

1. Surveillance Network:
    a. Antimicrobial resistance information bank ,
    b. FluNet and RABNET ,
    c. Global Salm-Surv ,
    d. East Asia Network for HIV (EAN-HIV)
2. Community Alert Network:
    a. Outbreak verification list ,
    b. Weekly Epidemiological Record ,
    c. Health Alert Network (HAN) , USA
    d. APEC EINET
3. Expert Systems
    a. US CDC NEDSS
4. (Inter-) National Information Exchange and Communication Network
    a. Health InterNetwork (HIN) , USA
    b. WHO GOARN
5. Medical and Biological Research Networks:
    a. Roland Koch Institute (RKI) , Germany

An important part of the global e-Health framework for pandemic control, however, is to establish an 'Emergency Response Network' (ERM) that is able to handle all occurring diseases, especially unknown ones. This includes the above sub-networks each of which was designed for a different purpose and phase during the outbreak cycle.

The proposed solution for a framework has to be realised both at the national and global levels. While global networks provide information exchange based on certain standard semantics, national level of the framework implements most of the controls. The focus of the international implementation, however, is on information exchange, and it has the following levels:

- Organization/Government Level
- Process Level
- Service/Application Level
- Information and Communication Technology (ICT) Infrastructure Level

This paper discusses the issues at each of the above levels with respect to various stakeholders, barriers and problems for implementation with reference to different phases of a possible outbreak/disaster cycle, e.g.,

- Prevention
- Detection and Verification
- Early Response
- Sustained Response
- Recovery

The presentation will conclude with a demonstration of a geographical information system for Pandemic Surveillance and Control software developed as part of a collaborative effort by the Australian industry and universities.

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Nine-Years Experience In Telemedicine for Rural & Remote Districts of Russia: From Teleconsultations to E-Diagnostic Centers and Development of the Health Delivery System

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Abstract -These materials give you basic knowledge about development of the Russian telemedicine on the base of videoconferencing units.

I. Introduction

The Russian Federation is in transition period to international principles of health care delivery shifting the focus to primary health care (PHC). Strengthening PHC requires qualified medical staff including general practice doctors and nurses. Training of medical staff should be based on long-term planning and result from strategic needs. In this respect, the scientifically-justified method of determination of long-term needs of the health sector in staff will be developed and implemented. We think that only new information technologies and first of all the telemedicine paves the way for success of State medicine policy.

With the advent of telemedicine sufficiently developed countries receive an opportunity to successfully solve an important social problem - providing their citizens with equal access to high-quality medical care independent of the distance of their location from large medical centers or clinics.

As the world market survey shows there are multiple areas of application of videoconference facilities in medicine - from advice given by narrow specialists to psychotherapy sessions and remote control remote control of manipulators during surgery.

Practically, no major obstacle stands in the way of spreading this service throughout the world.

According to the media, more than five hundred telemedicine projects are currently underway throughout the world. The purpose of these projects is to provide remote assistance to patients in distant regions, where the infrastructure is not properly developed or where the standards of medical care are inadequate.

II. Competitive Product

One of the examples of a successful competitive product of the Russian Society of Telemedicine is the telemedicine project "Moscow - Russian Regions", whose favorable development may result in the offering of a range of intellectual products in the market. The idea of giving a patient a possibility to get high-quality medical advice independent of this patient or the consulting doctor location until recently was only a subject for discussion.

Effective implementation of telemedicine has become possible only with the development of modern telecommunication technologies. Particularly, the development of inexpensive high-speed digital ISDN & IP communication channels, which allow for simultaneous data transmission and reception through relatively cheap videoconference equipment developed for the PCs in the beginning of the 90s.

Now the cost of a permanent telemedical center set up on a turn-key basis in the region of Russia is $8,000 to 20,000 depending on its list of equipment (Fig.1).

By now we have three levels All-Russian videoconference network with more than sixty telemedicine points in rural and remote districts of the country. Each telemedicine point usually is placed in regional or district hospital and has the art video conferencing system and ISDN or IP channels (or both) and sometimes Space Satellite channel. We suppose that telemedicine points in district hospitals (third level of network) will be the base for organization tele-educational support for doctors of general practice and the nurses.

ISDN and IP digital communication channels are provided by Rostelecom, Comstar, TransTeleCom, and local communication operators within the framework of the Telemedicine project.

The leading manufacturers and suppliers of computer facilities and communication equipment ensure technical support and development of the project.

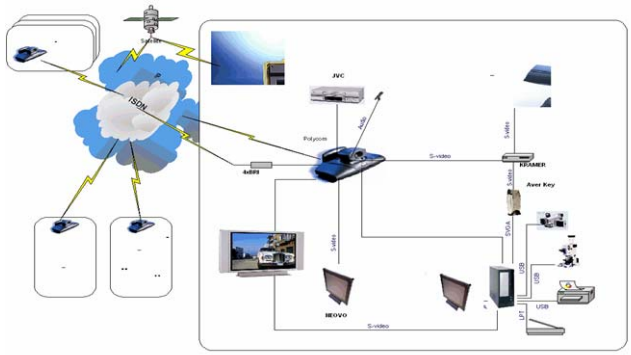

Figure 1 (a). Standard equipment of the regional telemedicine center

lectures delivered for physicians in 32 disciplines of medicine within the framework of the project.

III. MEDICAL VIDEO CONSULTATIONS

Basic lines of use of video consultations:

- Prehospital consultation of patients with leading Russian and foreign specialists to specify a diagnosis and to solve problems associated with a forthcoming operation
- Monitoring of patients in the late period after complicated operations after return to their region
- Emergency consultations of patients who have life-threatening conditions (cardiac diseases in the newborn, dangerous injuries, wounds, burns)

Consultation of patients treated in their region in order to correct therapy

Advantages of medical video consultations

- The high efficiency of a consultation due to the "live" contact of a consultant with a patient and his/her physician
- A rapid decision on a patient's referral for surgery

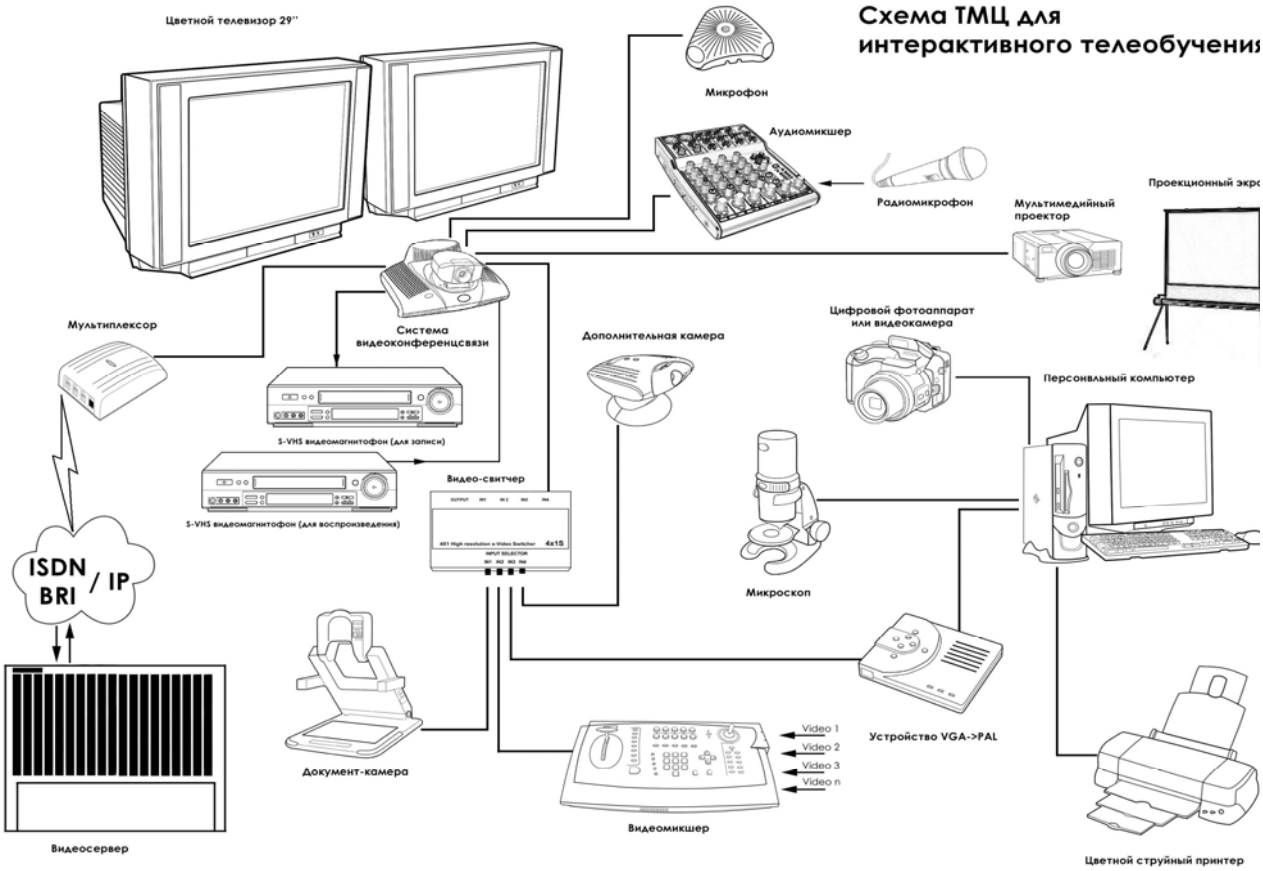

Figure 1 (b). Standard equipment of the regional telemedicine center – details

Today over 2000 medical video consultations are annually given from more than 60 regions of Russia and the former USSR countries and over 800 hours of TV

- The unique possibility of consultative support of patients after their return home
- Improvement of the professional skills of physicians from regional medical facilities during conferences of specialist doctors

- The saving of forces and money: the cost of video consultations is 20-50 times less that the total expenses on a trip to Moscow, the efficiency of a consultation itself being higher

IV. INTERACTIVE TELEEDUCATION

Areas of application of interactive teleeducation:

- Study of new methods for diagnosis and treatment by directly transmitting operations and diagnostic procedures just from theatres
- Teleschools, telesymposia, and teleseminars on different subjects, including those on the study of telemedical technologies
- Telelectures, certification cycles, and qualification-improving courses for physicians within the framework of postgraduate training

Advantages of teleeducation

- The simultaneous reading of lectures to several clinics from different regions
- Contact with unique specialists during teleeducation and topical lectures
- A "live" dialogue between a lecturer and the audience during telelectures and TV transmissions
- Demonstration of unique operations and diagnostic procedures simultaneously with a specialist doctor's comments, i.e. teletutorship
- A combination of lecturers with clinical discussions
- Training occurring without discontinuing work in the clinic
- Saving of the budget of clinics

V. OBVIOUS ADVANTAGES

The main advantage of video-conference communications as compared to video telephone consists in the availability of two additional data transmit modes, which considerably enhance the efficiency of the dialogue. The first mode allows the doctors, located in different cities to simultaneously read the same information on their PC screens presented in the format of several boxes: the picture of the counterpart, the medical history of the patient, roentgenograms, graphic materials (results of ultrasonic examinations, electrocardiograms, etc.), discuss and analyze the data, and jointly work out the final recommendations. The second mode allows the doctors to control a remote computer (to scroll the slides during the teleconference lecture, to perform patient's data search, or to find data on a rare disease in a database of a remote clinic, etc.). If we consider the fact that a video camera or a VCR can be connected to the videoconferencing system - to demonstrate diagnostics procedure or surgery, we can speak of practically the entire spectrum of medical information, available during teleconsultations or telelectures (see Fig. 1).

In contrast with an individual consultation of a patient by a clinic specialist, in teleconsultations, two doctors communicate - the patient's doctor and the consultant. As a result, in such a discussion, the consultant receives much more objective professional information about the patient, which enhances the efficiency of such communication between the doctors.

Many countries, where there is a lack of modern research medical centres, view telemedicine as a real opportunity to raise the quality of national medical care without the need for major capital investment.

They view it as an opportunity to work in close cooperation with the leading European and American clinics on the basis of videoconferencing technology (patients' consultations, personnel training, participation in teleconference symposiums and conferences).

VI. ECONOMIC EFFICIENCY

It should be noted that the basis for the development of telemedicine throughout the world is the understanding of economic efficiency of information technologies for cutting the costs associated with adequate treatment of each patient. Our research has shown that tele-consulations centres are economically feasible. The main result of the research was the fact that telemedicine consultations centres in small cities are a good return on small investments. For the local population such a centre provides an access to the world leading specialists, while the expenses of the individuals needing such consultations are significantly lower than the ones they have to incur for travelling to a clinic. Figure 1 shows the results of the economic feasibility study performed for a teleconsultations centre, scheduled to provide services to a small city or a region. The starting data were as follows: number of consultations per month - 100 scheduled and 10 urgent; cost of one scheduled consultation, including traffic - 80 dollars, discount rate -20 per cent. Under these conditions, paying off period of the investment (approximately 10,000 dollars) is 10 months. Figure 2 uses the following symbols for the money flow charts: 1 - loans, 2 - repayment of main debt; 3 -repayment of interest on loan; 4 -cash balance at the end of period; 5 -net profit [1]. Calculations show that it is practical to make small-scale investment into the teleconsultations centre to be able to provide an instant access to a medical

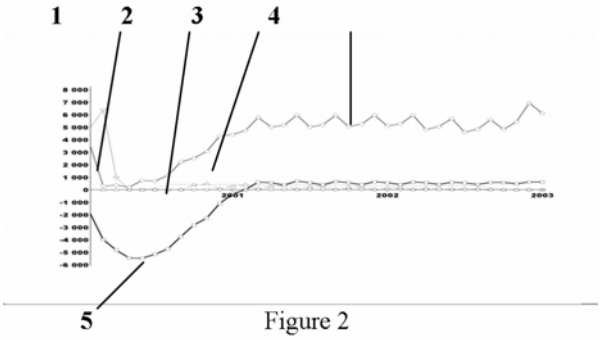

Figure 2

centre known for its success in diagnostics and treatment of the relevant diseases. Insurance companies also support new medical technologies, because investments in teleconsultations centres help cut the costs of patients transportation to the consultations centres and back.

VII. MARKET OPPORTUNITIES

The task is to identify the segment of this market, where overseas clinics will find it difficult to compete with the Russian service providers. It is important, because the above mentioned data indicate that many well-known medical centres of the USA and EC are striving to obtain leading positions in the actively developing international telemedicine market.

Using the SWOT analysis we can see that the most powerful factors favoring successful operations of the Russian telemedicine centres are as follows:

- Thousands of graduates from Soviet medical universities who live abroad and who will find that getting consultations from their professors is cheaper and easier, because they belong to one and the same school;
- Clinics built with the Russian assistance in the developing countries. These clinics used to have very close contacts with Russian medical centres, and for them it will be more efficient to reinstate old ties on a new basis, then to develop new ties with the Western clinics;
- Also, elements of information infrastructure using the Russian-built equipment, working on the basis of the Russian standards, and operated by the local experts who were trained in Russia.

The weakest point of Russian telemedicine is poor foreign languages training at the Russian medical universities, which will be a hurdle for the Russian medical consultants in the way to international information markets, although, most of our leading experts, especially those who have had traineeship abroad, don't have such problems. Real opportunities for entering the international telemedicine market are based on the fact that professional level and high skills of Russian doctors have never been challenged. We need to pay very close attention to providing telemedicine services to our compatriots living abroad: large groups

VIII. MAIN TRENDS

Last years has shown that for Russian distances the telemedicine equipment developed for mobile telemedicine systems are the best solving of the Doctor of general practice support in medical points of Russia's rural & remote districts.

Our experience in using portable equipment for mobile car (Fig. 3) systems and special train for medicine in disaster zones gives us confidence in success that together with our partners for best technical solutions for small Health Centers.

It means that each physician Health Center in Russia's rural & remote village have to be equipped with a set of diagnostic units compatible with digital telemedicine equipment in this Center or special digital converter that will support full compatibility of equipment has to be installed.

The main list of diagnostic units must include simple and complicated one: Digital stethoscope, Blood Pressure Measuring Device, Weight Meter, Glucose Meter, Blood Oxygen Saturation Level (SpO2) and Respiratory Flow Meter up to ElectrocardioMeters, EchocardioMeters, Ultrasound digital equipment and so on. Only images of x rays will be scanned, compressed and sent, but maybe digital and not very expensive x rays equipment will appear in the market very soon. The list is not closed and will permanently change. Of course this diagnostic and IT complex have to be controls by the new designed software. We hope that our experience in selection of diagnostic equipment for mobile telemedicine stations will help us exclude serious mistakes in this way for PHC.

It is our hope that within the next few years there will be telemedicine units in most parts of rural and remote districts of Russia. Feasibility studies have been completed and the first phase of execution is starting in frames of Federal Program "The Electronic Russia".

It should be noted that the basis for the development of tele-education throughout the rural and remote districts of the country is the understanding of economic efficiency of information technologies for cutting the costs associated with training process of each doctor. Our research has shown too that tele-education's centers are economically feasible. For the local population such a centre provides an access to the world leading specialists, while the expenses of the

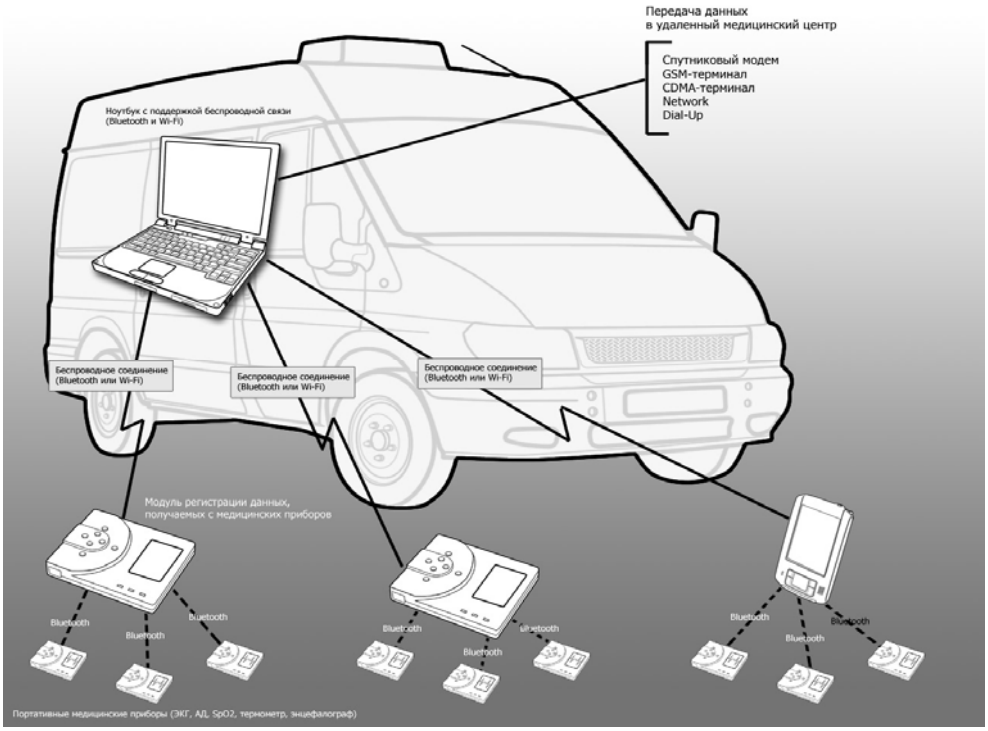

Figure 3. Mobile telemedicine point

individuals needing such studies and individual consultations are significantly lower than the ones they have to incur for traveling to a training center or clinic. Our colleagues from the Central Siberia assert that, each telelection for specialist from remote village is forty times cheaper than the same one in regional training center.

Our experience shows that new multy-points videoconference information technologies open for us modern ways for professional contacts: teleschools, teleseminars, telesymposiums.

This is very important when physician's Health Center in Russia's rural and remote village gets new modern diagnostic units – in any case tele-training is only way for quick installation and makes physician familiar with it.

IX. CONCLUSION

With the advent of telemedicine Russia receives an opportunity to successfully solve an important social problem - providing their citizens with equal access to high-quality medical care independent of the distance of their location from large medical centres or clinics. This allows us to confirm that the modern system of telemedicine consultations, covering the territory of Russia and integrated with the leading international centres of telemedicine consultations, has all the necessary capabilities to successfully operate on the world market of telemedicine services

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Telemedicine Segment of the Croatian E-Health System

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MAIN GOAL AND OBJECTIVE: promotes regional cooperation, assists in pre-planning for present/future TelMED (telemedicine) coalitions; service to remote locations, contribute to, and operate with NATO forces, become respectable partner with other partners, "to improve dialogue with local partners in issues and scenarios related to military emergency medicine, developing of modern teleheath of the 21st century, emergency planning"

BENEFITS: "telepresence" of the worldvide well known authorities in any MC of the Adriatic region/south-east Europe, emergency planning, intervention and momentary consultation/throughout 24 hrs in remote MCs, protection, successful emergency response, application of the latest technologies are closely followed and implemented in the health/telehealth care of both domicile population and foreign guests, supervision of TeleMED activities will be performed nationally, international agreements of the supervision should be developed and the possible need for international registration of doctors practicing TeleMED internationally shall be evaluated/developed.

In subsequent phases, the cost-effectiveness of a dedicated video server should be considered in order to archive high quality medical images and video clips. This will form a sophisticated and efficient database of medical records that could prove highly useful. The possibility of using this video server for educative purposes of both medical students and professionals should be seriously considered.

Keywords: telemedicine, e-health, medical images, medical record

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Session 14

How to Harness the Power of Internet for Competitive Health Care

A Global, Low Operational Cost and Zero Infrastructure Investment, Store and Forward Telemedicine Platform

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Store and forward Telemedicine systems have now been with us for some time. The ITC technologies upon which they are based are very mature now but the need for a low cost/no cost store and forward Telemedicine platform remains largely, unaddressed.

Even in the remotest areas of the world, communications infrastructure is developing rapidly leveraging such technologies as VSAT satellite communication and GSM as well as cable and fibre delivering ever increasing bandwidth. The key issue for most agencies now that the technology is becoming more generally available is the investment required to establish their own Telemedicine network.

To date, most 'commercial' Telemedicine systems have been developed and operated by consortia and alliances of one form or another and are provided as tools to their membership or employees. These 'systems' typically force users (medical practitioners) to work within bounds of reference defined by their management organizations and are not openly accessible to all comers.

The need exists for a Telemedicine platform that allows the users of the system to forge their own referral networks over a common platform. On this sits a human network of medical professionals that uses a system akin to an EMAIL application or service with which to communicate. This service must securely route CASE PACKAGES in a 'structured' and 'managed' fashion to other registered network users or groups of users, as defined by the initiating user. The results/outcomes of a referral/second opinion request would then be routed back via the same path.

i-MED.NET is a new Telemedicine system and service, launched recently, that addresses all of the above issues. In addition, the design terms of reference called for:

- A functionally rich and advanced store and forward client platform, applicable to many medical disciplines that incorporate all the necessary functionality within one application
- A platform that does NOT require any specialised hardware and software components, leveraging off-the-shelf computers, imaging devices and operating systems
- A platform that supports a pool of imaging devices through a broad range of industry standard interfaces
- An application interface that is very user friendly, simple to learn and intuitive
- Zero server platform investment for users or user communities
- Zero communications infrastructure investment other than 'standard', consumer level Internet connectivity for users or user communities
- A client platform that is very low cost to operate
- A system that leverages the public internet as its communications backbone but one that offers very high levels of security and patient confidentiality
- A platform that is PORTABLE – a solution that works equally well when disconnected from the network and one that automatically synchronises when network access is available.

i-MED.NET came online in Nov. 2005 and has achieved all of the design goals mentioned here.

Keywords: Telemedicine, Store and Forward, Internet

Application of VoIP Technology with Mobile Health Information System in a Wireless Hospital

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Abstract-National Taiwan University Hospital(NTUH) launched a pilot Voice Over Internet Protocol(VoIP) project which exploits existing wireless environment covering medical campus, main hospital and branch hospitals. IP phones with communication applications are provided to doctors, nurses, and staff in NTUH including direct calls, broadcasting, and conferencing. In this project VoIP technology integrates with a wireless hospital information system, enabling seamless and spaceless collaboration among medical professionals and administration staff to provide a continuous and comprehensive healthcare for patients in the hospital. Preliminary user survey was performed to investigate knowledge, attitude to VoIP applications, as well as their expectation for hospital information system in the future. The result shows users in this project generally understand and support VOIP technology.

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I. INTRODUCTION

NTU hospital has launched a pilot project to integrate VOIP technology with existing phone lines. There are 100 users, including doctors, nurses, technicians, and administrative personnel. They are distributed with three kinds of equipments: USB phones, WiFi phones, and PDA phones(Fig. 1). Communication functions provided include direct calls, broadcasting, and conferencing. Moreover, those IP phones can call people outside the hospital through hospital telephone servers, and users can be called from outside in the same way. The integration of VOIP and traditional phone lines marks the commencement of mobile health information system in a wireless hospital.

Figure 1 – VOIP devices

A. *VoIP Background*

As the Internet becomes prevalent, many applications which leverage the free energy appear, including VoIP applications. VoIP, Voice over Internet Protocol, transfers voice data over the Internet, and it saves tremendous communication cost in comparison with the traditional circuit-switched telephone network. Skype [1] is a well-known and successful application of VoIP.

B. *Toward a Mobiles Healthcare*

The same revolution can occur in a hospital setting. Traditional ways of communication among medical and paramedical personnel include wired phone lines and even shouting out loud in the hallway, which is inefficient and cost-high. Moreover, many health care scenarios have evolved to a mobile setting that both healthcare providers and healthcare receivers are moving in most of the caring process. For example, when a patient needs a CT scan, the communication between the technician in the scanning room and the nurse in the vicinity of the ward is a mobile communication scenario. To achieve an in-time, cost-effective, and ubiquitous communication, we have to combine VoIP and wireless network technology to develop a mobile telecommunication application.

C. *Wireless Environment in NTU Hospital*

In National Taiwan University Hospital, as well as the medical campus, wireless access points are deployed throughout the buildings. Web portal of the Intranet let doctors check their patient list and PACS data wherever they are. Another group of access points allows guests to the hospital to surf the Internet and receive emails. The wireless environment makes NTU hospital a place ready to develop mobile health information system.

D. *Goal of the VoIP Pilot Project*

In adapting to an increasing flow of patient information and communication around medical personnel, tradition phone lines have to be changed by incorporating state-of-the-art VoIP technology. VoIP brings the following benefits:

reduced cost, real-time and ubiquitous communication, instant access to patient information and user mobility.

The cost of a VoIP system includes deployment of wireless access point, equipment of VoIP phone, and the connection to the traditional phone line switch. The wireless access points have already been deployed in NTU Hospital. Only VoIP phone devices are the extra equipments needed. Intel collaborates with the system configuration. Therefore, the cost of setting up a VoIP system in NTU Hospital is low. Moreover, each call inside NTU Hospital Network is free, while calls to outside the hospital are paid by the hospital.

In addition to reduced cost, people carrying with VoIP phones can talk when they are walking, which provides users ubiquitous and real-time communications. In the future, patient information, decision support system, and PACS information can also be transferred by developing more functions integrated with the VoIP application, and finally the goal of a wireless hospital environment can be achieved.

II. METHOD

The VoIP system contains hardware equipments, wireless network deployment, and software components. VoIP is connected to the traditional phone lines through IPPBX server. User survey is also conducted before use of the system to demonstrate the difference before and after using VoIP system. The user feedback can be used for later development of more VoIP applications.

A. *System Architecture*

With the collaboration among information and communication system operators of NTUH, VoIP phone equipments and IPPBX server vendors, user applications software of the VoIP phones were developed and customized to the user needs. The VoIP system architecture is shown in Figure 2. IPPBX server connects tradition phone lines and VoIP system. Users dial a special code first when they call from outside the hospital. Meeting and broadcast can be arranged within the software interface as well as management of group and contacts. The messages over the VoIP network is packaged in accordance with the SIP protocol [2].

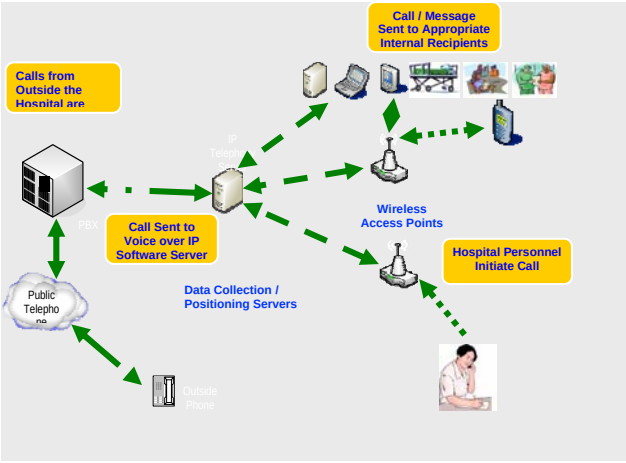

Figure 2 – VOIP System Architecture

B. *System Applications*

For user who wants to connect to another IP phone, each person's IP phone is assigned with a 3-digit number. To communicate with people using PHS phone provided by hospital previously, the user can dial the PHS number directly just like using extension telephone within the hospital. However, a PHS phone user needs to dial to a specific 7 digit number first and then dial the 3-digit IP phone number. To dial to an extension telephone, an IP phone user first dials 981 instead of 980 for PHS phone and then the 4-digit extension number of the NTU hospital. For desktop extension phone users, on the other hand, dial 1009 first and then the 3-digit number of the target IP phone. For users outside the hospital or GSM cell phone users, they can either dial to the hospital's central line: 2312-3456 with extension number 3494 and then the 3-digits IP phone number, or dial directly to 2357-6888 and then the target's 3-digit number. The IP phone users can also call out to public switched telephone network (PSTN) by diaingl 00 first and then the tradition phone numbers used in our country.

C. *User Surveyy*

We develop a user survey questionnaire for the VoIP system. The questionnaire contains three main sections: (1) user demographic data, and (2) user knowledge and attitude (3) user requirement for mobile hospital information application,. It is designed in order to test the users' understanding of VoIP technology. The scenarios of communication are asked to show the frequency and pattern of communication among users. For example, the contacts of a nurse might be doctors, and the way a nurse contact a doctor may use PHS or the traditional phone line. The analyzed communication pattern can be used to develop functions that improve efficiency of communication; for example, we can contact a person through text messages when he is not available to answer a phone call.

III. RESULTS

Three kinds of VoIP phones are used: USB phone, WiFi phone, and PDA phone. Clinical departments involved in this project includes: laboratory medicine, family medicine, resuscitation team, and Intern doctor. Department of hospital information service and administrative departments in main NTU hospital and Yun-Lin branch are also involved. The summary of equipment distribution is in Table 1.

A. *User Demographics*

There are totally 56 questionnaires collected back. Response rate is about 60%. In those returned questionnaires, 32 (57.2%) are male and 24 (42.8%) are female. 28 (50%) of them are at the age of 25-29, 7 (12.5%) at the age of 30-39, and 14 (25%) at the age of 40-49. There are 29 (51.7%) doctors, 14 (25%) technicians, 3 (5.4%) pharmacists, and 10 (17.9%) administration staff. 12 (21.4%) of them work for 1 year, 8 (14.2%) for 2 years, 4 (7.1%) for 3 years, 4 (7.1%) for 4-10 years, and 13 (23.2%) for 11-20 years. In terms of department, 13 (23.2%) are collected from laboratory

medicine department, 4 (7.1%) from family medicine, 17 (30.4%) from obstetrics department, 5 (8.9%) from pediatrics department, and 10 (17.9%) from administration departments. 25 (44.6%) of them works in patient wards, 12 (21.4%) in clinics, 3 (5.3%) in emergency department, 13 (23.2%) in laboratory, 15 (26.8%) in offices. 28 (50%) of them work 8 hours a day, and 27 (48.2%) of them work more than 8 hours a day, including 1 who works 15 hours a day. 15 (26.8%) of them need rotation.

Table 1. Device Distribution List

Department	USB	WiFi	PDA	Subtotal
Lab medicine	33	0	1	34
Info dept.	8	3	0	11
Family medicine	1	0	7	8
Resuscitation	0	8	1	9
Intern doctors	0	26	0	26
Accounting dept.	2	0	0	2
Accounting dept (Yun-Lin Branch)	1	0	0	1
Gen. Admin. Dept.	1	0	0	1
Gen. Admin. Dept. (Yun-Lin Branch)	1	0	0	1
Pharmacy dept.	1	0	0	1
Pharmacy dept. (Yun-Lin Branch)	1	0	0	1
Lab medicine (Yun-Lin Branch)	0	0	0	0
Info dept. (Yun-Lin Branch)	1	0	0	1
Superintendent (Yun-Lin Branch)	1	0	0	1
Total	51	37	9	97

B. *Scenarios of VOIP*

In daily practices, workers in the hospital have to communicate with their colleagues from time to time. Among these communication targets, doctors are the first ones to be called. Nurses are the second ones. Technician and administration staffs are also frequently called.(Figure3)

VoIP with wireless network not only integrate sounds and images, it also integrates data that provides the critical care of patients. The healthcare team can be steadily connected and efficiently share the information needed (Fig. 4).

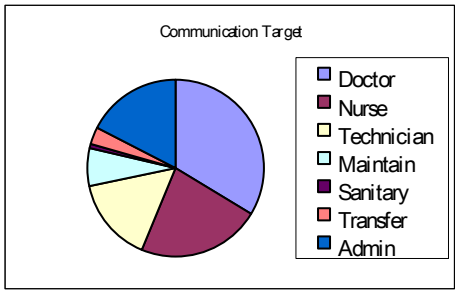

Figure 3 – Communication Target

Fig 4. Scenario of VoIP application

C. *User Knowledge and Attitude*

For user knowledge, we have surveyed users about what functions that VoIP technology can provide. For communication applications, direct internal calls, local calls, and distance calls are well understood. Users are less familiar with calls out to cell phones, conferencing, broadcasting, and net surfing. For user attitude, three major concerns are emphasized; namely, mobile device can improve work efficiency, patient-doctor relationship, and the mobile hospital information system can bring benefits. For these three questions, more than half of the users show satisfaction and positive attitude. This means that users generally support using VoIP to improve healthcare.

D.*Requirement for Mobile Hospital Information Application*

For the user requirement of hospital information system applications integrated with wireless technology, laboratory information and mobile electronic medical records are most important; the second ones are inpatient order entry and medical imaging system; the third is clinical decision support system, others system such as outpatient, emergency, community, public health Information systems are less emphasized. User friendly and system reliability are the two major factors that users deemed important when using these applications..

IV. DISCUSSION

In the US, Boston Medical Center (BMC) and John Hopkins University Hospital have deployed VoIP technology to help medical personnel in communicating with each other. System vendors include Cisco for both BMC and John Hopkins Bloomberg School of Public Health, and Nortel for San Antonio Community Hospital. In Taiwan, Chung-Hua Telecom and other 4 hospitals are developing mobile health care project which incorporates WiFi, 3G, and WiMAX technology.

In Japan, Internet technology is facilitated in three stages: firstly connecting two rural town hospitals with medical university, secondly establishing Metropolitan Area Network which connects three medical schools, and thirdly coins Virtual Global Network concept to connect Sapporo Medical University to hospitals in Obihiro and a preschool for disabled children. In the second stage, VoIP is used to provide one of the applications in their system[3]. In South Korea and Germany, V2oIP (Voice and Video over IP) is used to establish connections between elders at home and hospital doctors so that several services can be provided remotely [4, 5]. In summary, VoIP reduces the cost of communication no matter it is within a hospital, among hospital, or even from hospital to homes and schools. Data transmitted over IP can base on wireless or wired connection, dial-up or broadband. Regardless of the way they are connected, health applications using VoIP makes the communication and data transmit more easily and less costly.

A. *Challenges*

In this project, we decide to survey users before and after their usage of VoIP phones in order to compare the differences brings by VOIP system. In this stage we haven't finished the project, but users already have some feedbacks about the system. In terms of the equipments, users feel that it's too heavy and worry that they will lose it. Since the VoIP phone is not cheap, some users even lock it for fear of loss. In terms of usage rate, some users are not willing to use it because the stability of the system is not good enough, and afraid of the penalty of missing calls. Therefore, some users still rely on existing wired phone or PHS instead of using VoIP phone. The reliability problem is mainly due to the unstable wireless signal. Although wireless access points are deployed throughout the buildings, there are some corners that are not covered or penetrated thoroughly.

To solve these issues, there are two main focuses. The first is to design the equipment that is cheap and light-weight enough. The hardware problem will be solved as technology advances. The second problem, unreliable wireless signal can be solved by deploying more wireless access points and complete a total checking of the wireless covering range. If the services provided are reliable, users may be more willing to shift from tradition communication ways to the new ones.

B. *Calls to Outside Network*

Before the VoIP project, voice data to people outside the hospital is sent through traditional telephone switch and reach the outside telephone by wired lines. If the receiver end is another VoIP phone, we can transfer voice data through the Internet instead of using traditional phone line again. NTU hospital Yun-Lin branch also deploys VoIP system, and the connection between branch hospital and the main hospital in Taipei can be now made by the Internet so that the cost can be reduced.

V. CONCLUSION

After NTU Hospital launched the VoIP project, we have experiences in system issue and requirements. For system issues, there are device costs, maintenance cost and wireless deployment costs. By calculating these costs and the traditional phone line costs, both in assets and operational cost, the cost saved can be more lucid. As for the questionnaire, more questions on user friendliness can help us improve and design the future information systems with VoIP technology.

We also learn some criteria from this project. Voice quality, system reliability and connection reliability, functionality of the system all determines whether the user will change from the old communication method to the new one. Integration between hospital information system and mobile technology such as VoIP is another important criterion for a success.

In the Future, we can integrate more communication methods into the system, such as emails, text messaging, VoIP. With intelligent scheduling, we can avoid disturbing people and let them choose their preferable way of communication. RFID is another important function to integrate with VoIP to provide identity and tracking functions. With RFID, the scheduling of different communication ways and the identification of people and their location can be easier to achieve; thus brings us a wireless hospital environment.

VI. ACKNOWLEDGMENT

The authors thank Intel for providing VoIP devices, NTU hospital information team for assistance in system development,

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CLINIC: Collaborative Platform for Supporting Knowledge Management Processes in the Healthcare Sector

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Abstract- The paper is composed by two parts. The objective of the first part is to define a new approach to the innovation process in the health care sector. In fact, in more recent years, the attention to process oriented change management techniques has also emerged in the public sector, through attempts to draw from private sector, searching for new methodologies and managerial approaches that can satisfy the need of organisational innovation. CLINIC project analyses these techniques in one of the healthcare processes. The second part of the paper is more related to the new IST tools that should be used to improve the efficiency and the effectiveness of healthcare organisations. In particular, the project aims at validating innovative, user-relevant, wireless technologies which make the relationship between the healthcare professionals easier.

I. Introduction

Medical research, clinical evidence and case studies (trials) enormously increased (and will continue to increase) the medical knowledge.

On the other hand the progressive specialization of medical doctors and healthcare professionals gives way to the creation of specialized and often very technical knowledge domains, dedicated to elites of specialists, difficult to be shared to family doctors and healthcare professionals in general, outside these restricted circles [1].
So it is possible to say that the increase of medical knowledge conflicts with the diffusion and usage of it in the "usual" daily medical practice exercised by general practitioners and by family doctors operating on the territory, who are lightly linked to the research networks and to the scientific community.
This paradox (wider and wider medical knowledge practically used by less and less segments of HC professionals) can be overcome by the CLINIC service which aims at "making effective knowledge available and immediately usable by any Healthcare Operators (GPs, family doctors.) operating on the territory".
The main objective of the CLINIC project is to roll out a web and mobile based, medical service, enabling the exploitation of a collaborative work environment for the Management of Health Knowledge and Competence in the context of large health care systems.

Basing upon a well tested and mature technology, CLINIC project aims at validating on the market a range of services specifically targeted on the needs of the category of actors previously described. The market validation exercise under the framework of eTEN programme aims precisely at validating this scheme under a Trans European dimension.
The set of specific services that CLINIC will make available in the European market are:

- **Information & Knowledge Service**: this service would manage the healthcare Knowledge and should include the following functionality:
    1. Knowledge Sending: that should consider users knowledge sending to the system.
    2. Knowledge Query: that should consider the users consultation of all the knowledge stored and addressed by CLINIC service.
- **Collaboration Service**: this service should allow CLINIC users to interact and communicate with the each other.
- **Healthcare content databases on servers on line**: this service allows all content providers (healthcare networks operators) to link their database of contents (text, images). A key benefit of this tool is the capability for knowledge experts—with little or no programming experience—to author knowledge content quickly, without the assistance of third-party suppliers or information technology resources. It is an easy-to-use, automated authoring applications embedded in the system, including an editor that eliminates the need for HTML knowledge.

II. THE INNOVATION PROCESS IN THE HEALTHCARE SECTOR

The first knowledge domain addressed by the project will be the Cardiology; it is planned to extend it to the other healthcare environment. To reach this objective, CLINIC will enhance the state of the art in technology based knowledge management services, by the use of a web and mobile based platform able to facilitate the transaction of knowledge and competence between healthcare experts and operators and to support the professionals in taking evidence-based decisions at the point of need.

A knowledge management service will help to gather and organize the amount of knowledge and experience required to address the health problems daily brought to the attention of general practitioners and specialists, and to make it available even to the remotest family doctor or hospital [2].
Here CLINIC fits into a wider education and training activity, aimed at improving and increasing the knowledge and the participation of family doctors to the identification of the correct clinical path to be followed for each patient, at the same time establishing a consolidated collaboration network between the originators of specific knowledge and the healthcare operators using and applying such knowledge to real cases.

In this context CLINIC project is aimed at developing innovative knowledge management (KM) infrastructures able to transform *the healthcare organisation* at any level inside Europe into knowledge driven and dynamically *adaptive learning organisations* and empower *healthcareprofessionals* to be *fully knowledge doctors.*
The expected results from CLINIC project are:

- *Three re-designed Knowledge Management processes* related to large healthcare organisations in Italy, Greece and Romania;
- the *CLINIC Toolkit* designed to facilitate the implementation of Knowledge Management in large, multi-site, healthcare organisations, based on the *Knowledge Warehousing tools* and the *Mobile Collaboration tools.* ;

Therefore, the project outcomes are to make a decision making faster and better informed, to improve the customer services, to increase the returns on investment as productivity, to save time and staff resources, to push to the innovation which is further stimulated by capitalising on knowledge and expertise, to reduce the costs.

III. 3 THE KEY PROCESS: THE KNOWLEDGE MANAGEMENT

In order to be effective, the innovative process has to be funded on the existence, the development and the integration of the following four leavers related with the innovation key: the *policy*, the *culture*, the *organisation* and the *technology* [3]. These four elements are so linked among them, that it's not possible to act on one without acting on all the others otherwise the effectiveness of the innovative actions is reduced. Along with the leavers, it's possible to identify four engines: *benchmarking*, *project management*, *total quality management* and *digital signature*. Combining the leavers with the engines, it's possible to identify the three main process which characterise the healthcare organisations innovation: the *Change Management* (CM), the K*nowledge Management* (KM) and the C*itizen Relationship Management* (CRM) [4]. CLINIC project is focused on the Knowledge Management (KM).
The knowledge is a combination of experience, values, information and specific competence which provides a framework for the assimilation of a new experience and new information. The knowledge comes from the information and, at the same time, the information comes from the data. So, the knowledge could be obtained by information through the instruments of the comparison, the consequences, the connections and the conversation [5]. But the knowledge is not an information enriched with content, it implies a judgement, involves the values, the emotions and the people perceptions, which generate a relevant impact on the available knowledge in the organisations [6]. The knowledge has to be correlated to the action because it is always a knowledge towards an "objective".

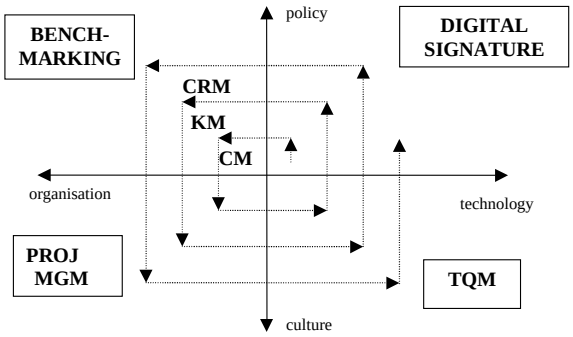

Figure. 1. The innovation sources for implementing knowledge based processes in healthcare organisations

The knowledge could be classify in three main macro-typologies [7]:

- *declarative knowledge* (knowledge "about" something);
- *procedural knowledge* (knowledge of "how" something occurs);
- *causal knowledge* (knowledge of "why" something occurs).

There's a more general classification of the knowledge. The *explicit knowledge* is codified, expressed by formal and linguistic modalities, easily transmissible and conservable which can be expressed through words and algorithms. For Nonaka and Takeuchi (1995) this kind of knowledge is formalised, easily communicated and shared. The concept of *tacit knowledge* was introduced by Polanyi, who evidences the importance of a "personal" method to build the knowledge, influenced by the emotions and obtained at the end of a process of active creation and of organisation of the individual experiences [8]. It is difficult to define in a formalised way, it is linked to the reference context and it is personal. To be able to spread the tacit knowledge inside the organisation, it needs to convert it in words and numbers which could be understood by everybody. During this conversion, from tacit to explicit, the organisation knowledge is created.
Each organisation has a unique asset of knowledge and its internal problems. Each action of *knowledge management* has

characteristics which are specific of the body for which it has been projected. The organisations could assure KM procedures oriented to the results and the strategic needs of the context where they operate, focusing the attention on the planning and the carrying out of the following areas:

- *process*: it assure the *KM* is aligned with the specific managerial processes.
- *organisational dynamics*: they over the barriers which obstacle the sharing of the knowledge and promote the innovation behaviour.
- *technology*: it allow people to share the activities using known instruments

The knowledge has also to be created. The mechanism of the knowledge creation is the condition and the "engine" of the innovation, in the two dimensions of the business innovation and the social innovation. The key point is the mobilisation and the migration of the knowledge across the organisation: it's necessary to rethink the capability of the organisation to encourage the relationships among people, or at least not to put obstacles in their way. The KM process is classify in:

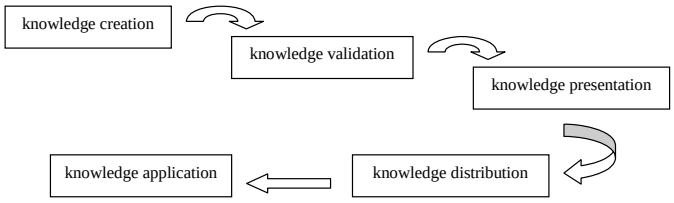

Figure. 2. The five phases of the KM process

The main aim of the healthcare organisation is to transfer the knowledge from tacit to explicit, from individual to collective, from collective to organisational:

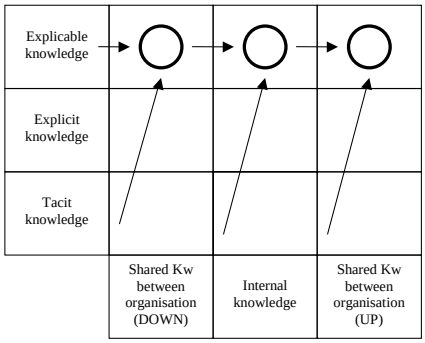

Figure. 3. the mapping of knowledge

IV. 3 INFORMATION AND KNOWLEDGE SERVICE

In this context the aim of The "Information & Knowledge" service is to enable all CLINIC user categories to share information that can be crucial in the improvement of healthcare patients care process. This sharing process can be realized either by experiences exchange or through a better consciousness of available pharmaceutical products and therapies with medical devices.

CLINIC is a service devoted to Health professionals and, as it's aimed at building and consolidation a users' community (of HC professionals) , users must register (a "guest" registration is offered to evacuate the system features, with limited access and no knowledge provision rights).

The "Information & Knowledge" service should consider two different user roles:

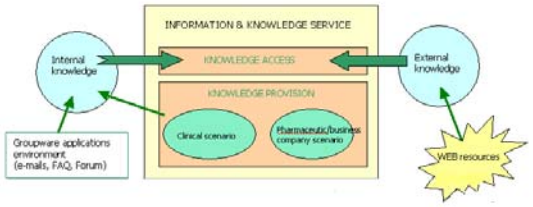

Figure. 4. Information & Knowledge service structure

- Knowledge sending: it will take into account knowledge contribution to the system and it will be carried out by all the system user categories identified in the system.
- Knowledge query: it will take into account access to knowledge stored by the system and it will be carried out mainly by medical staff.

In this context, two kinds of user-system interaction situations should be emphasized (see the Figure above):

- The user accesses the system looking for helpful information that could improve the treatment process of a patient and increase his/her medical knowledge
- A user wants to provide knowledge to the system. In this case, he/she can provide information/knowledge either uploading papers, documents, images, links to interesting external resources (i.e. Internet) or through the groupware environment tools (e-mails, FAQ, etc.).

V. THE SYSTEM ARCHITECTURE

The CLINIC platform will be structured around the following items:

- A web-based *Intranet Knowledge Warehousing* Toolset that will allow to build a wirelessly accessible knowledge warehouse. The knowledge warehousing will amass *internal* and *external knowledge*;
- *A Mobile Collaborative Environment* (built on Web-based Groupware tools), to support a realistic collaboration and knowledge sharing and transferring also among geographically distributed workforces, within and between public administrations. It will represent the convergence of technologies such as multimedia document/image management, videoconferencing, and mobile 3G technologies helping healthcare organisations transcend all sorts of boundaries (geography, time and organisational structure) by *making available the right information to the right employee at the right place and at the right time*.

The CLINIC platform is based on a *Intranet Knowledge Warehousing* Toolset. These tools will allow to build a wirelessly accessible knowledge warehouse (knowledge resources will includes manuals, letters, responses from

citizens/companies, news, technological, organisational, legal and other relevant information from administrations, as well as knowledge derived from work processes) applications that support inter-organisational learning process.

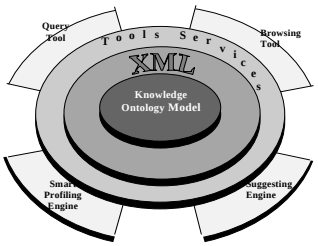

Figure. 4. The CLINIC Knowledge Warehouse

The second Tool which composes the CLINIC platform is the *CLINIC Mobile Collaborative Environment.* The Groupware can help Public Administrations transcend all sorts of boundaries. Geography, time and organisational structure fade in importance in the groupware-enabled process. At the same time, mobile technologies are increasingly penetrating businesses, offering anytime/anyplace access to enterprise information. The novelty of the CLINIC approach lies in the convergence of these two technologies.
The challenge of Mobile Groupware Tool development within CLINIC is twofold:

- firstly, to allow for web-based, mobile groupware by supporting both *synchronous* (ie, real-time interaction such videoconferencing, chatting, electronic whiteboard, etc.) and *asynchronous* (ie, email, group discussions, etc.) communication, including live video/audio/text communications;

secondly, to take full advantage of the Knowledge Warehousing tools, by integrating mobile groupware facilities within the CLINIC Toolset. *This will lead to set up of a full Mobile Collaborative Environment.*

VI. Conclusion

The KM will result into a decisive improvement in inserting an information database. This allows the healthcare professionals to access easier to the needed data, independently from the place where they are.
Concerning the exploitation of project outcomes for the industrial component of the Consortium, this will mainly result in the commercialisation of the prototypes and services validating within the project. All services will be used as basic elements to develop and produce marketable results: as in-house developments by each partner and in collaboration with project partners. A quick process of research transfer in production will assure to the Consortium partners an essential competitive advantage for a further consolidation of the respective positions on the market. The specific techniques implemented in the project will be used by most of the Partners to enhance the techniques already in use, contributing to consolidate a competitive advantage.
Within this structure, the willingness of the healthcare organisations involved in the project to provide a common exploitation of the project results, constitutes the cornerstone of the CLINIC Exploitation Strategy.

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International Law and Telemedicine

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ABSTRACT

Telemedicine is by definition an interdisciplinary field mixing medical science, telecommunications, ethics, law, deontology, trade… As cyberspace doesn't know any border, telemedicine is at the crossroads of many legal texts addressing various issues: electronic medical record, standards, e-commerce, liberalization of trade in services, access to health services and quality of information on the Internet…

Many organization generate rules, nevertheless there is no strategic vision. Indeed, telemedicine is a matter of concern for states, regional trade blocks (European Union, Mercosur, Alena) and international organisations such as: the World Health Organization (WHO), the World Trade Organization (WTO), the International Telecommunication Union (ITU), UNESCO and the World Bank.

The World Summit for the Information Society held in Tunis last November committed ITU's members to 'build a people-centred, inclusive and development-oriented Information Society, premised on the purposes and principles of the Charter of the United Nations, international law and multilateralism.' However, international health law remains the main source of legislation with different texts related to the human right to health or bioethics. Moreover, international labour law, international criminal law, international economic law do contribute to the emergence of a legal basis to approach the e-health 'nebula'. The fragmentation of legal sources is a result of the various objectives assigned to these organizations: protection of health, development of trade, etc…
From a systemic viewpoint, the interests on telemedicine and its applications are not the same in developed or developing countries. While developed countries discuss the cost-effectiveness of telemedicine, developing countries need to access rapidly tele-consultation and medical training via e-learning. In addition to this North-South divide, markets are still in their infancy and wonder how to develop their potential. The private sector interests contrast with those of Non Governmental Organisations which are in the position to defend patients' rights.

There is a lack of methodology and an urgent need for international cooperation and better dissemination of existing information: make an inventory of the current situation with regard to the international legislation, identify gaps and priority areas and identify common subjects to avoid duplication of work. This will make telehealth a real success as improved quality and access to care at a lower cost and without raising professional objections.

KEYWORDS

Cooperation, cyberspace, international, law.

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Late Submissions

A Web-Based Data Bank of Heart Rate and Stroke Volume Recordings during Sleep

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Abstract - Heart rate variability is widely used in clinical medicine as a diagnostic tool and as a prognostic marker for coronary artery disease. Many of sophisticated heart rate variability analysis methods are used including spectral methods as well as methods of non-linear analysis. However, the theoretical assessment of potentially relevant methods with respect to their efficiency is difficult. Therefore the experimental approach is used where the corresponding data bases are of special importance. The goal of the study was the development of a public Web-based DataBank of heart rate, stroke volume physiological signals, and related data. Our primary goal was collection and standardization of heart rate and stroke volume data for investigation of sleep structures, however the developed DataBank can be useful for a broad audience, including medical scientists, mathematicians, engineers, clinicians, and students working in biomedical sciences and in the development of related technologies.

I. INTRODUCTION

For the contemporary medical diagnoses huge amount of data collected by different physical measurements and biochemical analyses are available. Frequently data comprehension falls behind data collection, e.g. expensive tests are planned where elicitation of relevant information from relatively cheaply collected data might be possible. Since some of the measurement methods are more expensive than the others, an urgent problem of data mining is extraction of all knowledge, relevant to the considered disease, from the results of inexpensive measurements. To facilitate the developers of diagnostic related data mining methods the creation of medical data banks provided with standard data analysis methods is important [1],[2]. A good example is the PhysioBank [3].

Heart rate variability is widely used in clinical medicine as a diagnostic tool and as a prognostic marker for coronary artery disease. We are interested in investigation of relation between heart rate and stroke volume variability, and sleep structure. For consistent experimentation a data basis of corresponding physiological signals is needed. Starting with creation of the mentioned data basis we extended the original goal, and finally the Web-based DataBank containing broader data basis has been created [4]. It has been provided also by various methods for investigation or variability of time series.

A basic method of evaluation of sleep structure is polysomnography where sleep stages are identified from the brain activity, eye movements, muscle activity, heartbeat, blood oxygen levels and respiration data recorded during overnight stay in a sleep laboratory [5].

Since recording of interbeat interval (RR) and stroke volume (SV) sequences is much cheaper procedure than polysomnography, recognition of sleep stages from the features extracted from RR and SV sequences would be very advantageous. However, preliminary results show that reliable automatic classification using investigated parameters of RR sequences is not obvious [6]. Further computationally intensive experiments with large data sets are needed to prove/reject hypothesis on possibility to identify the sleep stages automatically and reliably from the records of RR and SV sequences.

The well known PhysioBank [3] is a large and growing archive of digital recordings of physiologic signals and related data for use by the biomedical research community. PhysioBank currently includes databases of multi-parameter cardiopulmonary, neural, and other biomedical signals from healthy subjects and patients with a variety of conditions with major public health implications, e.g. sudden cardiac death. However, most of the databases there do not include indication of sleep stages (hypnograms), therefore such records are not suitable for the investigation of methods aimed to recognition of sleep stages.

The MIT-BIH Polysomnographic Database [7] included in PhysioBank archive is a collection of recordings of multiple physiologic signals during sleep. Sleep stages are annotated in this database, and interbeat intervals may be extracted from the recorded ECG. However stroke volume data required for our research are not included. Another drawback of this database is its size – only 16 records are included.

Therefore there is a need to develop Web-based DataBank of heart rate and stroke volume records and related data (e.g. tuned hypnograms). Some additional data on patients has been included which can be important for interpretation of results of HR and SV analysis, e.g. sex, age, health status, etc.

The goal of the study was the development of a public Web-based DataBank of heart rate and stroke volume physiological signals and related data for use by the scientific research community.

II. DATABANK

A. Contents of DataBank

DataBank [4] is a large and growing archive of well-characterized digital recordings of physiologic signals of cardiovascular system and related data for use by the biomedical research community. DataBank currently includes 3 following databases: time series of interbeat (RR) interval, time series of stroke volume (SV) values, and related data: sleep stage coding and personal information of investigated subject. These databases include physiologic signals in each recording that may be freely downloaded. The brief tutorial followed by pointers on downloading data and information about the archives themselves is presented. The lengths of these records vary, but in average they are about 7-8 hours long. DataBank currently includes databases of cardiovascular signals and other biomedical data from 50 healthy subjects and 759 patients with a variety of conditions such as coronary heart disease, congestive heart failure, premature beats, atrial fibrillation, sleep apnea, and aging. Apnea – DataBank consists of 275 RR interval recordings, each typically 8 hours long, with accompanying sleep apnea annotations obtained from polysomnographic study of simultaneously recorded respiration signals and is accompanied by a manually-scored hypnogram. DataBank currently occupies about 9 gigabytes and is growing.

B. General Data

All healthy subjects and coronary artery disease patients were subjected to a battery of tests (resting state, active orthosthatic test (AOT), bicycle ergometry (BE), night sleep etc.) with continuous recording of ECG, RR interval, and stroke volume values (impedance cardiography), which were also fed in parallel into the computer (Fig. 1).

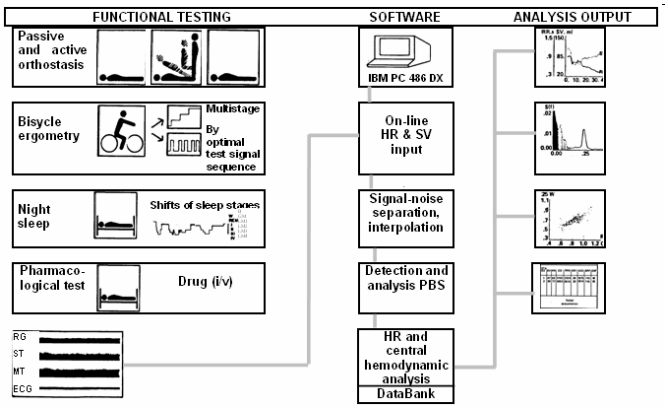

Figure 1. Blok diagram of heart rate and stroke volume recording and analysis.

DataBank consists from HR and SV records during following functional testing conditions:

Active orthostatic test - as a measure of the cardiovascular functional reserve depending on the autonomic heart rate control level, predominantly parasympathetic one.

Multistage bicycle ergometry - as a measure of physical fitness and aerobic cardiovascular reserve conditioned by chronotropic and hemodynamic responses to exercise.

Night sleep with the shifts between the individual sleep stages as a naturally occurring testing condition, giving an opportunity to assess an autonomic heart rate control and hemodynamics without employing exercise, to evaluate restoration over the night.

The scheme presenting HR and SV recordings and acquisition during individual testing conditions as well as different analysis methods is shown in Fig. 2. It is worth to mention that our system includes also sophisticated methods: analysis of vector time series, visualization by means of multidimensional scaling, and optimization based classification.

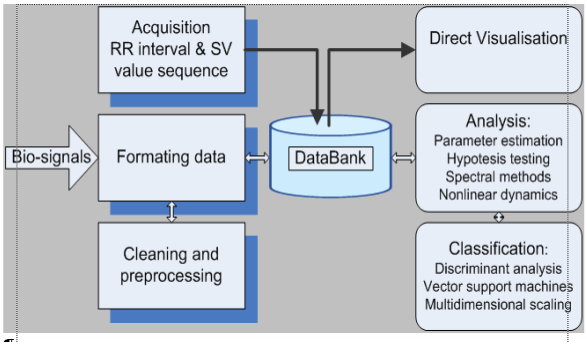

Figure 2. Scheme of functional testing and physiological signal analysis.

C. Heart Rate and Stroke Volume Data

The original HR and SV recordings (from ECG records unrefined) were digitized at 500 Hz. The normal data were obtained by automated rhythm analysis with automatic and manual review and correction.

All these data are recorded during overnight stay in a sleep laboratory. This method is expensive for assessment of patient's sleep. On the other hand, the medical doctors-experts in sleep problems can evaluate the sleep structure heuristically from heart rate related data. Since recording RR and SV sequences is much cheaper procedure than polysomnography, recognition of sleep stages from the features extracted from RR and SV sequences would be very advantageous. The example of a hypnogram, i.e. the graph of sleep changes in time, obtained by means of polysomnography is shown in Fig. 3.

In the same figure the graphs of RR and SV sequences are shown. Hypothetically the automatic and reliable reconstruction of the hypnogram from RR and SV sequences is possible.

Healthy persons and coronary artery disease patients sleep heart rate interval and stroke volume data files of subjects presented in Fig. 4 as single database.

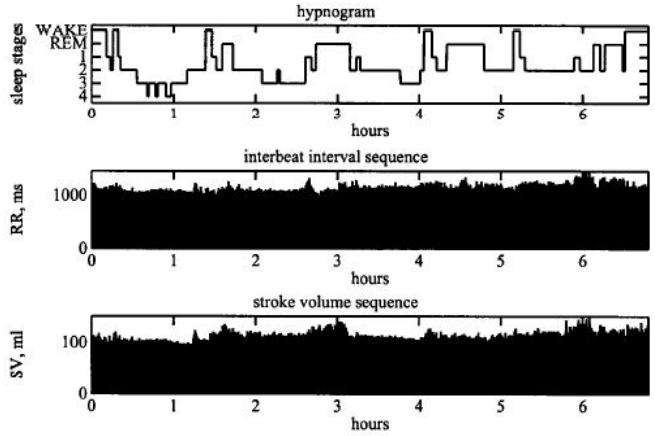

Figure 3. Hypnogram and interbeat interval and stroke volume sequences.

Heart rate and stroke volume data files stored in DataBank have additional information about the investigated subjects as well as about different heart rate disturbances. First, the records were made from healthy subjects or CAD patients. Second, the records are characterized by the severity of sleep apnea. Third, what kind of rhythm disturbances are found in the record; and fourth, the type of HR sleep pattern during sleep which reflects the level of HR variability modifications during the shifts of sleep stages.

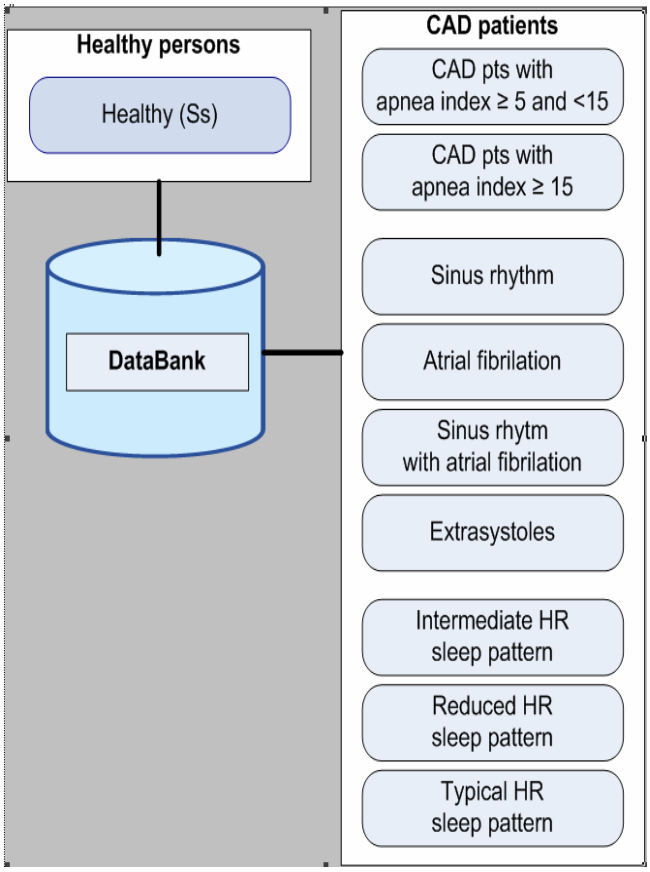

Figure 4. Scheme of additional information about the each HR & SV record.

There is a records set, identified by the record name. Lists of record names for each database can be found. In most cases, a record consists of at least four files of RR, four files of SV and four files of both records time (hypnogram records) which are named using the record name followed by extensions, which indicate their contents.

TABLE 1
NUMBER OF HR &SV RECORDS IN DATABANK WITH DIFFERENT CLINICAL CHARACTERISTICS, RHYTHM DISTURBANCES AND HR PATTERN.

Characteristics	Count
Healthy persons	45
CAD patients	759
CAD pts with apnea index ≥ 5 and <15	142
CAD pts with apnea index ≥ 15	132
Sinus rhythm	102
Atrial fibrillation	33
Sinus rhythm with atrial fibrillation	11
Extrasystoles	58
Intermediate HR sleep pattern	141
Reduced HR sleep pattern	55
Typical HR sleep pattern	186

D. About Records

In header file: *.ptn (in ASCII format) presented patients code, sex (1 – man, 2 – woman), age (year), height (cm), weight (kg), sleep tests code (501 always), sleep tests number, tests date and time (Lithuania date format: yyyy, mm, dd,; and time format: HH:min (24 hour time format (GMT+02:00) Vilnius, Lithuania).

In binary format each sample is represented by a 16-bit amplitude in binary form (i.e., 32,768 amplitude stored from second byte. First value is undefined value. Normal Sinus Rhythm RR Interval Beat for each QRS complex (heart beat) (about 6 - 8 hours each). Each file name is associated with each record.

Interbeat (RR) Interval (Data format records with extension

*.rr - RR originals in binary format (16-bit amplitude);
*.rrt - RR originals in ASCII form (in column);
*.rrm - RR normal sinus rhythm in binary format (16-bit amplitude);
*.rit - RR normal sinus rhythm in ASCII form (in column).

Stroke Volume (SV) Interval Data (Data format records with extension)

*.sv - SV originals in binary format (16-bit amplitude);
*.srt - SV originals in ASCII form (in column);
*.svm - SV sinus in binary format (16-bit amplitude);
*.sit - SV sinus in ASCII form (in column).

Hypnograms (Records time information)

Hypnograms are represented as time or range of records in ASCII form with space between numbers. Hypnograms are represented RR and SV records sets.

Hipnogram code (Sleep stage codes) presented:

Four digits combination – the code of segment of sleep record **XYZW**:
where **X** - number of sleep cycle (from 1 to 8).
Y - code of sleep stage (from 1 to 8), and:
1 - sleep stage S1;
2 - sleep stage S2;
3 - sleep stage S3;
4 - sleep stage S4;
5 - REM sleep;
6 - wakefulness before sleep;
7 - wakefulness after sleep onset;
8 - wakefulness after night sleep.
Z - number of the sleep stage recurrence inside sleep cycle (from 1 to 9):
9-means i-th number of stage, before REM sleep, i=1, 2.
Combination when **X**=1, **Y**=6:
Z=1 - laying on back;
Z=2 - laying on left or right side;
Z=3 - after "lights off".
Combination when **X**=8, **Y**=8:
Z=1 - laying on back;
Z=2 - laying on the right side;
Z=3 - laying on the left side.
Note! When **Z**=9, not summarize during stages.

W - parameter describing stationarity of HR record,
where number means following:
1 - stationary record (suitable for analysis);
2 - artifacts (not suitable for analysis);
3 - records with premature beats (extrasystoles);
4 - records with atrial fibrillation;
5 - records with paroxysmal tachycardia;
6 - records with disturbances of heart conduction system;
7 - records with Sleep apnea (print separately);
8 - records with body position on the left or right sides (do not calculate haemodynamic parameters and print separately);
9 - non-stationary record (not suitable for analysis);
0 - not interpolated record, but used for calculations.

III. DISCUSSION

The heart rate variability based diagnostics are investigated in many research and clinical centres. Most important conclusions on applicability of a method are justified by results of experimental results. To guarantee consistency of the experimental assessment of data analysis methods consistency data bases used by different research centres should be guaranteed. Important experimental results have been obtained by various researchers using PhysioBank [3], and this data bank is widely recognized. However, this famous data bank is scars in data needed for investigation of methods for development and validation of different HR analysis methods as well as for recognition of sleep stages from RR interval records, as mentioned above. We have developed the DataBank [4] containing RR interval and stroke volume data with additional information about these records. This DataBank containing records from healthy subjects and CAD patients with different forms of heart rate disturbances can be used for the purpose mentioned above.

However, the interesting question is a consistency of both data banks. It is a complex problem challenged by mathematical, medical, and computational difficulties. A similar problem in mathematical statistics is formulated as hypothesis that two samples belong to the same parent population. There are several methods for testing such a hypothesis. However, in our case collected data represents different groups of patients which can be similar with respect to some characteristics, but be different with respect to the other characteristics. For example, the records in DataBank are specified according to the clinical characteristics presented in Table 1, but such a specification is missed for the records of PhysioBank.

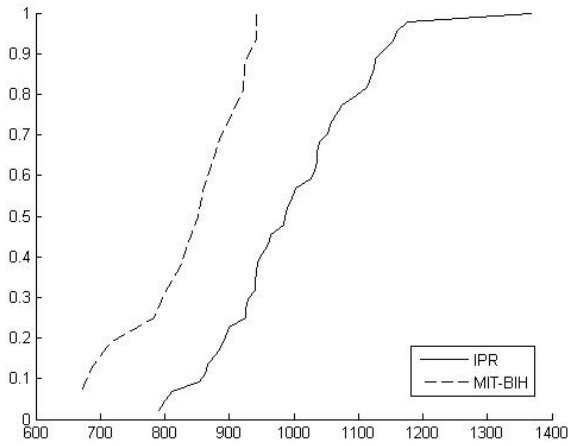

Figure 5. Comparison of cumulative distribution functions of samples of empirical means of RR intervals for whole records.

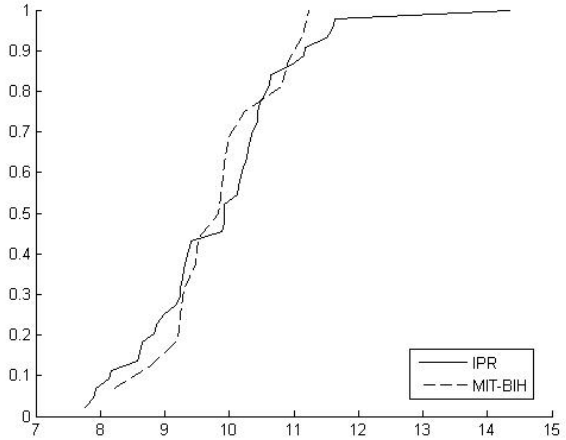

Figure 6. Comparison of cumulative distribution functions of samples of empirical standard deviations of RR intervals for whole records.

At the moment we do not have well justified methodology for testing the consistency of biomedical data from different data bases. Emphasising importance of the general problem, we have to restrict our analysis with some particular solutions. We consider all 16 records from PhysioBank, and 45 records of healthy persons from DataBank. First, we compare cumulative distribution functions of samples of

empirical means and empirical standard deviations of RR intervals estimated for whole records from DataBank and PhysioBank. The corresponding graphs are presented in Fig.5 and Fig.6. They show that mean heart rate frequency during sleep of PhysioBank patients (n = 16) is faster than of DataBank patients (n = 44). However, standard deviations in both cases are similar. It means that HR and SV records in both banks are collected from subjects having different autonomic HR control as well as clinical status. Fifty records from healthy subjects with normal autonomic control in DataBank is advantage.

The results of restricted investigation do not show discrepancy in data from both data banks. Therefore we conclude that both data banks are consistent contain consistent data, but emphasize the necessity of many-sided investigation of the consistency problem.

CONCLUSIONS

The developed web-based DataBank offers free access to large collections of recorded physiologic signals intending to foster interaction among investigators from many different disciplines.

ACKNOWLEDGEMENT

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The Luxembourg Heart Failure Project: A New Concept of Tele-Home Monitoring For Patients Suffering From Congestive Heart Failure *(CHF)*

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Epidemiological background

Congestive heart failure (CHF) has become a health problem of epidemic proportion in the western world. CHF affects 5,000 – 10,000 people in the Grand Duchy of Luxembourg and is the leading cause of hospital admission for patients over 65. Better methods of secondary prevention are urgently needed to reduce life threatening situations and health care costs. In most cases a conventional pharmaceutical therapy has only modest effects on morbidity, mortality and quality of life [2].

According to results of SHAPE (Study on Heart failure Awareness and Perception in Europe) 3.6 million new heart failure cases are reported each year in Europe. About 14 million people in Europe are affected today and this number will probably increase to 30 million by the year 2020. CHF related hospitalisations have more than doubled in the last 20 years. Heart failure patients experience a lower quality of life than patients suffering from any other chronic disease [1]. In France the costs of treating heart failure are estimated between 109-208 M€ every year [6]. The German heart foundation reports, that Germany spends approximately 286 M€ per year on the treatment of about 1.5 million heart failure patients [7, 8]. Recent studies have shown that re-admission, length of stay and hospital charges are significantly decreased when tele-home monitoring systems will be applied to CHF patients [1]. It is assumed that reduced re-admission rates will also have a positive effect on the quality of life.

Expected Results

The Luxembourg Heart Failure Project (LuHF) aims to develop a home monitoring system, able to improve the quality of life of CHF patients as well as reducing their hospital stay. One important requirement is that elderly and disabled patients may use this system easily. Another necessity is, that the system can be used as Information Technology (IT) platform in CHF managed care programs.

Objectives

Our multidisciplinary research project will improve the currently available methods of home tele-monitoring for CHF and assesses its health economic impact in five different steps:

1. Determination of practical physiologic parameters (e.g. blood pressure, ECG, weight) to be measured non-invasively by the patient himself.
2. Set up of a tailor-made home monitoring system adapted to the needs of patients with CHF.
3. Development of a data transfer and evaluation system to analyze the patient's health status at a distance.
4. Conducting of a randomized clinical trial to compare a group of home-monitored patients to a group of conventional treated patients.
5. Analyze the effects of home monitoring in CHF on Quality of Life (QoL) and Health Care Costs.

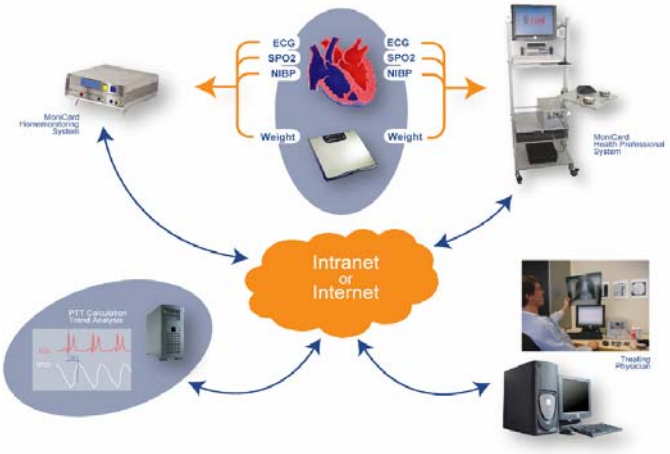

Figure 1: MoniCard supports CHF-specific Managed Care Systems.

Public health relevance

Patients with CHF report a considerably reduced quality of life because of physical symptoms and functional disability. Today, the most effective therapy for end-stage CHF is cardiac transplantation. However, because of limited donor organ supply, transplantation is limited to younger patients. This leads to poor prognosis and frequent hospitalizations combined with emotional and economic burdens. The EPICAL study shows annual re-admission rates of 2.5 hospitalizations per patient and 27.6 hospital days per year [2]. McMurray estimates a CHF prevalence rate of up to 13% for people over 65. Due to the increasing average age of the western population, these are major contributors to rising health-care costs.

The American Heart Association has estimated that the hospital costs per discharge are about 14,000 US$ per CHF patient [3]. A recent study has indicated that home-based intervention with visiting nurses can decrease the rate of re-admissions and associated health-care costs [9]. Two recent studies have shown that hospitalizations can be reduced if CHF patients are monitored on weight, heart rate and blood pressure [4].

It is our hypothesis that well-adopted home monitoring systems will improve the quality of life for patients with congestive heart failure by reducing hospital stays and the need to urgent re-admissions.

Methods

It is required, that all measurements could be done at the patient's home without the help of a health professional. Health estimations, only based on regular telephone calls ('telephone triage') are often bias related. Especially when direct contacts with health professionals are substituted by telemedicine, it is important that degradations have to be detected in time; otherwise the patient will possibly ignore first symptoms, believing that he is well supervised. To minimize possible risks of the patient, a set of physiological parameters was determined, usable for a computer-aided analysis of the patient's health status at a distance. Comprehensive market analyses have shown, that not a single system was available on the market, which fulfils all projects requirements, so a tailor-made solution was set up.

Development of a CHF specific homemonitoring solution

The LuHF project has developed two different versions of MonICard, a specialized *Monitoring Instrument for Cardiology*. Both versions are able to record a one-minute Electrocardiogram (ECG) synchronously to the patient's oxygen saturation (SPO2), supplemented by non-invasive blood pressure (NIBP) and weight.
The "*MonICard Health Professional edition*" with its integrated Electronic Patient Record (EPR) is designed to identify suitable patients in hospitals and intensive care units. It facilitates the data administration and allows a complete follow up of the patient, even after discharge.

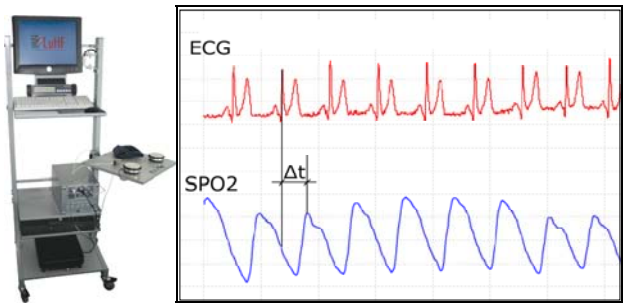

Figure 2: MoniCard Health Professional edition, schematic PTT calculation

The "*MonICard Home Edition"* will be used for outpatient's measurements at home, without any help of a health professional. The small box has an innovative "two buttons" handling and the patient is guided through the different measurements (ECG, SPO2, NIBP, weight) automatically by voice instructions. According to the patient's health status, a *one-minute-measurement* per day should be sufficient.

Figure 3: MonICard Home edition with two buttons handling and voice guide

All measured vital signs will be encrypted and electronically signed before being transmitted to the central "MonICard Analyze Unit". The data transmission could be based on telephone-lines; GSM-mobile telephone network or TCP/IP based Internet technology.
The "MonICard Analyze Unit" computes a set of health indicators like Pulse Transit Time (PTT) and Heart Rate Variability (HRV), which will be used for an estimation of the patient's health status at a distance. First results with a limited number of in-patients have shown that our estimation method helps the cardiologist to recognize early health fluctuations and allows him to adjust the pharmaceutical therapy accordingly. This should save the patient from emergency hospitalizations and life threatening situations.

CHF-specific Electronic Patient Record (EPR)

All patient measurements and CHF-specific data (e.g. six minutes walk tests, cardiac output measurements) are stored in an Electronic Patient Record (EPR), which gives the treating physician or cardiologist a patient related overview about actual and former pharmaceutical therapies, surgeries

and co-morbidities. Results of Quality of Life (QoL) measurements, the quantity of hospitalizations and even DICOM images could be stored in this EPR database. All steps on the clinical pathway could be attached with prices and costs to support a fast health economic evaluation. Hence, the MonICard database can be used as coherent data storage system for clinical studies and health economic evaluations.

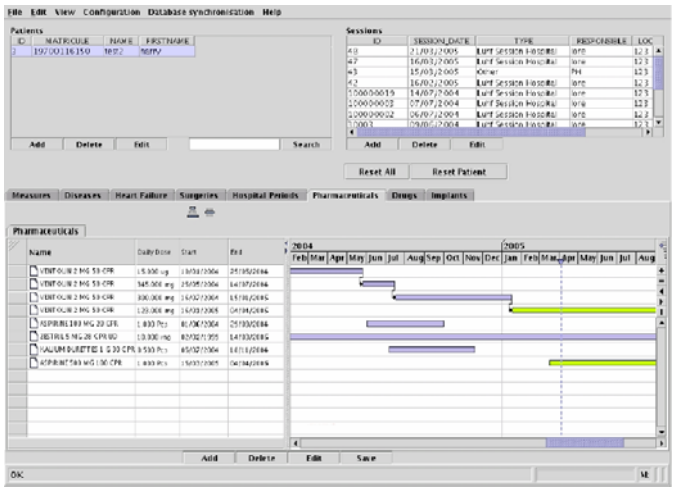

Figure 4: MonICard Electronic Patient Record for CHF patients

A graphical user interface (GUI) visualizes the medical data to support a fast interpretation. To simplify the control of the patient's data, it is possible to install this GUI as well on different types of computers (Windows, Mac, Linux) and even on a doctor's laptop at home.

Information technology (IT) supported Managed Care of CHF-patients

The increasing demand from official authorities to reduce health care costs promotes the development of home monitoring solution. Reimbursements strategies have to be negotiated with the health care insurance companies in order to maintain home monitoring feasible.

Based on the preliminary results, new implementation strategies of cost effective tele-health care services should be developed. Strategic plans are necessary to guarantee the acceptance of the systems in the medical environment. The potential impact of a home monitoring system on health care costs and quality of life is considerable. Unfortunately most initiatives have been funded as biomedical development projects without systematic analysis of public health requirements. Therefore our multidisciplinary research project LuHF will improve the currently available methods of home monitoring for CHF patients and increase its usefulness and reliability. The MoniCard-system was developed as an electronic interface between patients and health professionals. It offers the possibility to integrate the patient directly in an IT-supported managed care system and should lead to more efficient medical service.

Next steps

Today, the system will be evaluated with CHF-patients (NYHA Class III-IV) in Luxembourg and two university hospitals in Germany and France. By using the method of a health economic evaluation, we will estimate effects on quality of life and health care costs. Events such as death, readmissions and hospitals days will be recorded. A qualified nurse and a cardiologist will review patient data on a daily basis. If necessary, patient treatment will be adapted during outpatient's appointments.

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Appendix II

Med-e-Tel 2006
Exhibition and Conference Guide

(108 pages)

Exhibition and Conference Guide

MedeTel

The International Trade Event and Conference
for eHealth, Telemedicine and Health ICT

LUXEXPO
LUXEMBOURG

April 5-7, 2006

U.S. Army Medical Research & Materiel Command's

TELEMEDICINE & ADVANCED TECHNOLOGY RESEARCH CENTER (TATRC)

WORLD-CLASS LEADERS IN STATE OF THE ART, CUTTING EDGE MEDICAL TECHNOLOGY

Army Telemedicine Partnerships:
"Reaching People... Meeting Needs"

Please visit TATRC's booth at Med-e-Tel to learn about our capabilities.

USAMRMC MISSION

To provide technologically advanced medical solutions for military requirements to protect and sustain the force.

Phone (301) 619-7927/2413
Fax (301) 619-2518
www.tatrc.org

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LUXEXPO
LUXEMBOURG

Welcome

Dear Participants,

Welcome to Med-e-Tel 2006, the International Trade Event and Conference for eHealth, Telemedicine and Health ICT. We are proud to have, once again, representatives from more than 50 countries from around the world here with us in Luxembourg.

The increased use and implementation of ICTs into healthcare practice does create a need for close cooperation and mutual understanding among medical professionals, IT specialists, telecom engineers and other stakeholders involved. Med-e-Tel offers such a forum to share experiences, gather information, discover products and innovative technologies, and network with colleagues from around the world. And our world class conference program opens up windows to a multitude of ICT applications in the modern healthcare environment.

The Role of Advanced Technology in Global Healthcare Challenges and Opportunities will be addressed by the Telemedicine and Advanced Technology Research Center (TATRC), an element of the US Army. The session covers implementation of broadband networks, mobile solutions, operational standards, environmental sensors, telemedicine technologies, and TATRC's international activities.

Aims and results of various current *European eHealth Projects*, supported by the *European Commission*, will also be presented in various of the conference sessions and on the exhibition floor. These projects deal a.o. with telemedicine services for homecare, accessibility planning for disabilities, reducing risk management by knowledge-driven networks, mobile computing environments. Two projects will even conduct full scale workshops here at Med-e-Tel: *Healthware* (a major 'telemedicine via satellite' project on a European scale) and *Doc@Hand* (focusing on knowledge sharing and decision support for healthcare professionals).

Extensive focus will be placed throughout the conference on *Homecare and Health/Disease Management*, covering topics such as medication compliance, telemonitoring of vital signs, fall detection, video communication, and more. Home telehealth offers affordable and sometimes even necessary solutions to face the challenges of early hospital discharge, an ageing population and the associated rise in chronic conditions, and a predicted nursing shortage.

The *International Initiative for Ubiquitous Healthcare (u-Health)*, conceived as part of the future activities of IEEE Healthcom, will present its views on how collaboration between countries and the *Use of Broadband and Wireless Mobile Technologies* can help to provide healthcare to people anywhere, anytime.

A returning topic at Med-e-Tel is the one of *eHealth for Developing Countries*. eHealth is an important tool to cope with the specific healthcare problems that exist in the developing world (shortage of qualified doctors and specialists, AIDS/HIV pandemic, etc.). This year's sessions will be chaired by *World Health Organization (WHO)* and *International Telecommunication Union (ITU)* representatives, who are at the forefront of telemedicine and ehealth implementation in the developing world. Also the role of *Satellite Communication and Space-Based Technology Applications in Healthcare*, especially for developing countries and for remote and isolated areas, will be explored in one of the

conference sessions and a poster exhibition, coordinated by the *United Nations Office for Outer Space Affairs (UNOOSA)*.

The Luxembourg *CRP-Santé* (Institute for Research in Healthcare, Public Health and Biotechnology) will conduct a regional symposium, focusing on *how IT services at the patient's disposal will lead to new strategies and solutions for hospitals, healthcare insurance providers and the industry*. The symposium will provide an overview of current realizations and future projects and present several business cases which will illustrate successful applications in automated appointment booking, online consultation of electronic patient records, CRM, telemonitoring, RFID, mobile applications, electronic signatures, and health portals.

Our partnership with the *International Society for Telemedicine & eHealth (ISfTeH)* also continues to grow and we are pleased to welcome many of their members here at Med-e-Tel. International networking is a major factor in the global development of Telemedicine & eHealth and the coordinated efforts of ISfTeH and Med-e-Tel are of vital importance. A special ISfTeH session during Med-e-Tel will be dedicated to I*nternational Telemedicine and eHealth Initiatives and Developments and features*, together with a poster exhibition on the ISfTeH exhibition stand, information about the activities from ISfTeH's worlwide membership.

We encourage you to talk to every exhibitor on the show floor, find new and interesting products and applications, explore potential synergies and establish new business relationships. Their products, services and technologies are essential to the successful implementation of Telemedicine & eHealth programs.

Med-e-Tel also presents the *Media Corner* once again where you can find information on some 30 magazines, journals, books, reports and online information services in the fields of telemedicine and ehealth. These publications are all valuable information resources in today's fast changing world, allowing you to stay up-to-date with the latest news and developments. Take a seat and enjoy your reading!

Finally, we welcome you to attend the Med-e-Tel Welcome Reception on Wednesday evening at Casino Luxembourg and the Exhibitor and Attendee Reception, offered in cooperation with the u-Health Initiative, on Thursday evening here at Luxexpo. Two perfect networking opportunities and a chance to digest all you will have discovered and learned throughout the day. We hope you will also take the time to discover Luxembourg, the beautiful host city of Med-e-Tel and we look forward to having you again with us in 2007 (April 18-20).

Jean-Michel Collignon
CEO
Luxexpo
Producers of the Med-e-Tel Exhibition and Conference

General Information

Dates & Venue

April 5-7, 2006
Luxexpo
Luxembourg, Grand-Duchy of Luxembourg

Registration

Wednesday 5 April	09:00-17:00
Thursday 6 April	08:00-17:00
Friday 7 April	08:00-16:00

Opening Ceremony

Wednesday 5 April	09:30-10:00

Followed by Ribbon Cutting and a Visit of the Exhibition with Official Invitees

Exhibition

Wednesday 5 April	10:00-17:30
Thursday 6 April	09:30-19:30
Friday 7 April	09:30-16:00

Conferences & Meetings

Wednesday 5 April	11:00-17:30
Thursday 6 April	09:00-17:30
Friday 7 April	09:30-16:00

Social Events

Welcome Reception

Wednesday 5 April 18:00-20:00

Casino Luxembourg, 41 rue Notre Dame
Luxembourg city
Offered by Med-e-Tel

Exhibitor and Attendee Reception

Thursday 6 April 17:30-19:30

Luxexpo, Exhibition Floor (Exhibits Open)
Offered by u-Health and Med-e-Tel

For General Information on Med-e-Tel, please contact:

Luxexpo
10 Circuit de la Foire Internationale
1347 Luxembourg-Kirchberg
Luxembourg
tel: +352 4399 1
fax: +352 4399 315
e-mail: info@medetel.lu
website: www.medetel.lu

International Sales and Coordination Office (Belgium):

tel: +32 2 269 84 56
fax: +32 2 269 79 53
e-mail: medetel@skynet.be

For Tourist, Hotel & Dining Information:

Luxembourg City Tourist Office
tel: +352 22 28 09
fax: +352 46 70 70
e-mail: touristinfo@lcto.lu
website: www.lcto.lu
Or consult the Med-e-Tel Registration Desk

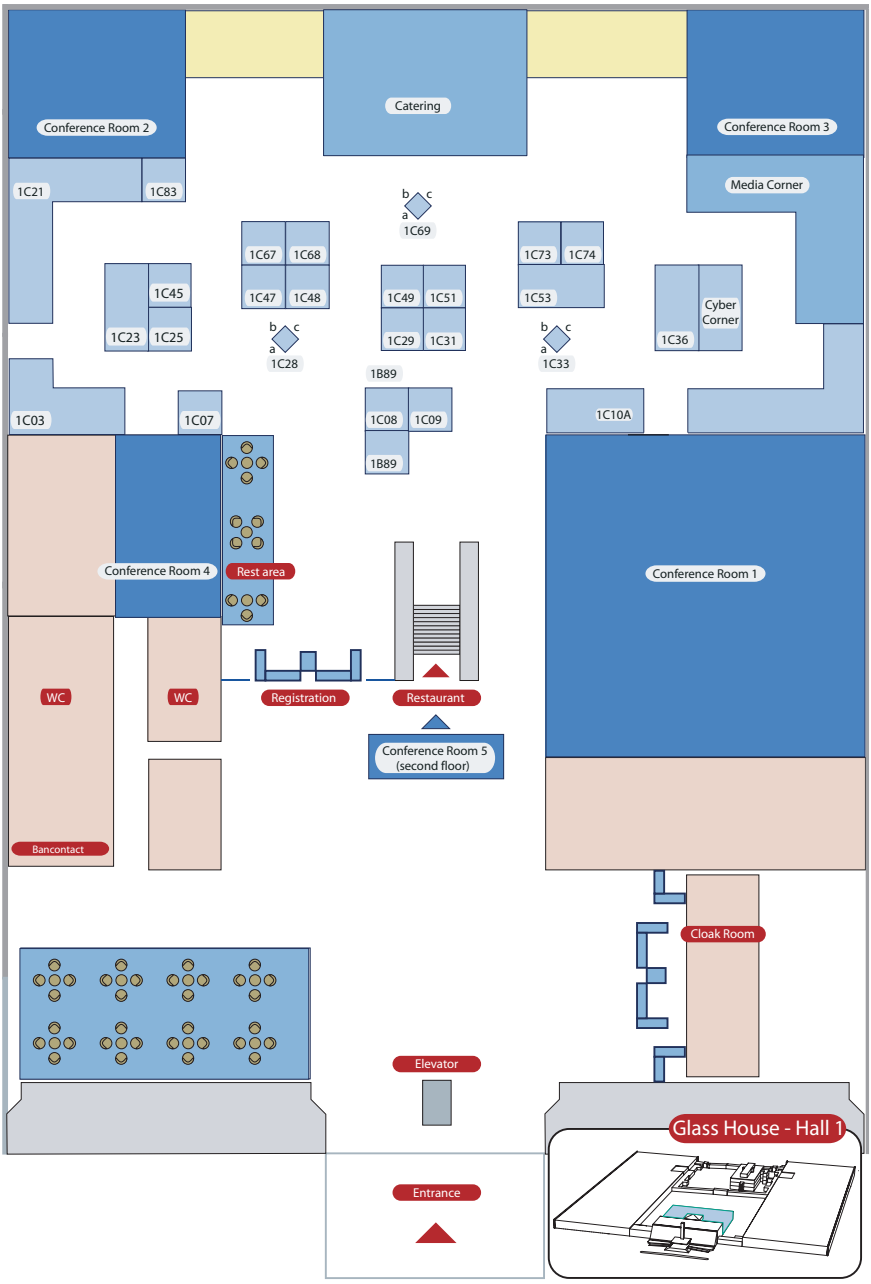
Thank you to IST Results for co-sponsorship of the Med-e-Tel Conference Bag

Schedule

	Exhibit Hall	Conference Room 1	Conference Room 2	Conference Room 3	Conference Room 4	Conference Room 5
Wednesday 5 April 2006						
08:00-09:00	Registration					
08:30-09:00	Coffee					
09:00-09:30						
09:30-10:00		Opening Ceremony				
10:00-10:30	Exhibition	Ribbon Cutting + Guided Tour of Exhibition				
10:30-11:00						
11:00-11:30		Opening Session				
11:30-12:00						
12:00-12:30						
12:30-13:00		Lunch + Exhibits				
13:00-13:30						
13:30-14:00						
14:00-14:30			Homecare & Health Management (1)	Tele-education: A Must for Success	IT Solutions in Healthcare (1)	
14:30-15:00		TATRC Symposium: Global Healthcare Challenges and Opportunities: The Role of Advanced Technology				Meeting of the EHTEL "Empowering the Citizen" Task Force
15:00-15:30						
15:30-16:00		Break + Exhibits				
16:00-16:30						
16:30-17:00		TATRC Symposium (cont'd)	Healthcare Challenges	IT Solutions in Healthcare (2)	Community eHealth and Disease Surveillance	
17:00-17:30						
17:30-18:00						
18:00-18:30	Welcome Reception @ Casino Luxembourg (bus transfer from Luxexpo available at 17:30)					
18:30-19:00	Offered by Med-e-Tel					
19:00-19:30						
19:30-20:00						
Thursday 6 April 2006						
08:00-09:30	Registration					
08:30-09:00	Coffee					
09:00-09:30		CRP-Santé Symposium: Accueil et Ouverture*				
09:30-10:00	Exhibition	CRP-Santé Symposium: Presentation de Business Cases (1)	Telecardiology	IT Solutions in Healthcare (3)	CRP-Santé Symposium: Presentation de Business Cases (2)	Healthware Workshop: Improving Connectivity with Remote Areas for Equitable Access to Health Services
10:00-10:30						
10:30-11:00		Break + Exhibits				
11:00-11:30		CRP-Santé Symposium: Presentation de Business Cases (1) (cont'd)	eHealth in Developing Countries: The Future of Healthcare (1)	Electronic Health Records and Data Transmission	CRP-Santé Symposium: Presentation de Business Cases (2) (cont'd)	Break + Exhibits
11:30-12:00						Healthware Workshop (cont'd)
12:00-12:30		CRP-Santé Symposium (cont'd)				
12:30-13:00		Lunch + Exhibits				
13:00-13:30						
13:30-14:00						
14:00-14:30		CRP-Santé Symposium (cont'd)	eHealth in Developing Countries: The Future of Healthcare (2)	Doc@Hand Workshop: Knowledge Sharing and Decision Support for Healthcare Professionals		Healthware Workshop (cont'd)
14:30-15:00						
15:00-15:30		Break + Exhibits				
15:30-16:00		CRP-Santé Symposium (cont'd)				
16:00-16:30			International Initiative for Ubiquitous Healthcare (u-Health): Healthcare Anywhere, Anytime over Boradband and Wireless Mobile Technologies			
16:30-17:00						
17:00-17:30						
17:30-18:00	Exhibitor & Attendee Reception @ Luxexpo					
18:00-18:30	Offered by u-Health (International Initiative for Ubiquitous Healthcare) & Med-e-Tel					
18:30-19:00	Exhibits Open					
19:00-19:30						
Friday 7 April 2006						
08:30-09:00	Registration					
09:00-09:30	Coffee					
09:30-10:00	Exhibition	ISfTeH Session: International Telemedicine and eHealth Initiatives and Developments	Homecare and Health Management (2)	How to Harness the Power of Internet for Competitive Health Care		Healthware Consortium Meeting
10:00-10:30						
10:30-11:00		Break + Exhibits				
11:00-11:30		ISfTeH Session (cont'd)	Homecare and Health Management (3)			
11:30-12:00						
12:00-12:30						
12:30-13:00		Lunch + Exhibits				
13:00-13:30		Space Technology as a Tool for Delivery of eHealth (Under coordination of the United Nations Office for Outer Space Affairs)	Making Better Healthcare Service Best: Healthcare Challenges			
13:30-14:00					ISfTeH Board Meeting	
14:00-14:30						
14:30-15:00		Break + Exhibits				
15:00-15:30						
15:30-16:00						

* CRP-Santé Symposium: L'informatique au service du client-patient: nouvelles stratégies et solutions pour les hôpitaux, les caisses de maladie et l'industrie

Floor Plan


Conference Room 2
Catering
Conference Room 3
Media Corner
1C21
1C83
1C69
1C67
1C68
1C47
1C48
1C45
1C23
1C25
1C49
1C51
1C29
1C31
1C73
1C74
1C53
1C36
Cyber Corner
1C28
1C33
1B889
1C03
1C07
1C08
1C09
1C10A
Conference Room 4
Rest area
Conference Room 1
WC
WC
Registration
Restaurant
Conference Room 5 (second floor)
Bancontact
Cloak Room
Elevator
Glass House - Hall 1
Entrance

Floor Plan

1B-89	European Association of Healthcare IT Managers (EAHITM)
1C-03	European Commission
1C-07	Pharmionic Systems
1C-08	Cardiocom Multi-Disease Management
1C-09	European Health Telematics Association (EHTEL)
1C-09	Healthware
1C-10	International Society for Telemedicine & eHealth (ISfTeH)
1C-10	eHIT
1C-21	Poster Display under Coordination of the United Nations Office for Outer Space Affairs (UNOOSA)
&	Space Technology as a Tool for Delivery of eHealth
1C-23	Space Technology-Based Telehealth Project Initiatives in Developing Countries
1C-25	Allgeier Computer
1C-28a	CASCOM
1C-28b	Telemedicine and Advanced Technology Research Center (TATRC)
1C-28c	IEM
1C-29	Aerotel Medical Systems
1C-31	Selligent
1C-33a	CRP-Santé
1C-33b	Ultragenda
1C-33c	Cegeka Healthcare Systems
1C-36	IBM
1C-36	I.R.I.S.
1C-45	Noesis
1C-47	Viterion TeleHealthcare
1C-48	Wireless Matters
1C-49	Doc@Hand
1C-51	YUSE
1C-53	HICT
1C-53	Telindus
1C-67	Honeywell HomMed
1C-68	Medixine
1C-69a	MAPPED
1C-69b	COCOON
1C-69c	u-Health
1C-83	Melexis Connectivity Solutions
1C-83	Omron Healthcare Europe

Conference Program

The following pages give an overview of the presentations that will be made in the Med-e-Tel conference sessions. Abstracts of presentations are available at the end of this guide in alphabetical order by title of the presentation. For full papers of the presentations, see Proceedings CD that is enclosed in the conference bag.

Wednesday 5 April 2006 - 09:30-10:00

Conference Room 1

Opening Ceremony

Opening addresses by:

- Alain Georges (Chairman, Luxexpo, Luxembourg)
- Mars Di Bartolomeo (Minister of Health and Social Security, Luxembourg)
- Yunkap Kwankam (Coordinator eHealth, World Health Organization, Switzerland)
- Greg Mogel (Deputy Director, US Army Telemedicine and Advanced Technology Research Center, USA)

Wednesday 5 April 2006 - 11:00-13:00

Conference Room 1

Opening Session

Chair: Frank Lievens

11:00-11:20 **The World Health Organization Strategy for eHealth**
Yunkap Kwankam, Coordinator eHealth, World Health Organization (Switzerland)

11:20-11:40 **Contribution of European Commission to Global Leadership of EU in eHealth Deployment**
Illias Iakovidis, Deputy Head of Unit, ICT for Health Unit, DG Information Society and Media, European Commission (Belgium)

11:40-12:00 **Telemedicine-Alliance Recommendations for Interoperable eHealth for the Citizens of EU - Needed Actions if We Want it**
James R. Kass, Telemedicine-Alliance, European Space Agency (The Netherlands)

12:00-12:20 **An Approach to the Telemedicine & eHealth International Structures and Initiatives**
Frank Lievens, Board Member, International Society for Telemedicine & eHealth (Switzerland)

12:20-12:40 **Relationship between Public and Private Sector to Establish a Sustainable eHealth Program in the Developing Countries**
Pramod K. Gaur, President & CEO, Viterion TeleHealthcare LLC, A Bayer-Panasonic Company (USA)

Wednesday 5 April 2006 - 14:30-16:10

Conference Room 1

Global Healthcare Challenges and Opportunities: The Role of Advanced Technology (1)

Presented by the Telemedicine and Advanced Technology Research Center (TATRC)

Chair: David M. Lam

Co-Chair: Ronald K. Poropatich

14:30-14:50 **Global Healthcare Challenges and Opportunities: The Role of Advanced Technology**
Greg Mogel, Deputy Director, TATRC (USA)

14:50-15:10 **Broadband Medical Networks, HealthGrid and Cyberinfrastructure**
Mary E. Kratz, TATRC Special Advisor, Broadband Medical Networks (USA)

15:10-15:30 **From the Front Lines: Innovating Mobile Health Care Solutions Bridging the Technology and Clinical Gap**
Tommy Morris, Director Mobile Computing Group, TATRC (USA)

15:30-15:50 **Telemedicine Standardization - The Need For An Operational Approach**
David M. Lam, European Liaison Officer, TATRC (USA)

15:50-16:10 **Telemedicine Deployment to Operation Iraqi Freedom - Current Status and Lessons Learned**
Ronald K. Poropatich, Telemedicine Consultant to the Surgeon General, USAMRMC (USA)

Wednesday 5 April 2006 - 16:30-17:30

Conference Room 1

Global Healthcare Challenges and Opportunities: The Role of Advanced Technology (2)

Presented by the Telemedicine and Advanced Technology Research Center (TATRC)

Chair: Brenda K. Wiederhold

Co-Chair: David M. Lam

16:30-16:50 **Virtual Reality for Behavioral Healthcare**
Brenda K. Wiederhold, Executive Director, The Virtual Reality Medical Center (USA)

16:50-17:10 **Environmental Sensor Development and Data Integration**
Kevin Montgomery, Engineering Director, National Center for Space Biological Technologies (USA)

17:10-17:30 **TATRC International Activities**
Jean-Louis Belard, Director International Affairs, TATRC (USA)

Wednesday 5 April 2006 - 14:00-16:00

Conference Room 2

Homecare and Health Management (1)

Chair: F. Buccolini

Co-Chair: B. Vrijens

14:00-14:15 **An Innovative Web Platform for Information and Knowledge Sharing with Ontology Driven Retrieval**
L. Sammartino, A. Conconi, G. Randall (Italy, UK)

14:15-14:30 **Electronic Monitoring of Dosing Histories Allows Real Time Detection of Poor Adherers and Offers the Bases for a Successful Intervention**
B. Vrijens, W. De Cian, J. Urquhart (Belgium, USA)

14:30-14:45 **The Relevance of User Evaluation Research for e-Health Application in the Homecare Setting**
S. De Rouck, M. Leys (Belgium)

14:45-15:00 **NFC - The Intuitive Link between People and e-Health**
G. Schreier, A. Kollmann, J. Morak, P. Kastner (Austria)

15:00-15:15 **Information Center for Persons with Disabilities**
E. Jitaru, A. Alexandru, I. Moisil, E. Tudora (Romania)

15:15-15:30 **eHealth and Digital Medicine in the Virtual Hospital of the Future**
G. Graschew, T.A. Roelofs, S. Rakowsky, P.M. Schlag (Germany)

15:30-15:45 **Telecare in Singapore Health Service**
F.S. Lim, Y.S. Tan, D. Kanagalingam, M. Foo, A. Ong (Singapore)

15:45-16:00 **A Home Care System Used in Post-Operative Patient Management**
D. Guerdal, A. Leis, I. Chouvarda, I. Lekka, M. Nerlich, N. Maglaveras (Germany)

Wednesday 5 April 2006 - 16:30-17:30

Conference Room 2

Healthcare Challenges

Chair: W.J.P.M. Calis

Co-Chair: R. Greenlaw

16:30-16:45 **DOKTER.NL Digital Consultation**
W.J.P.M. Calis, P.H.M. Mulder (The Netherlands)

16:45-17:00 **PARKSERVICE: Home Telemedicine and Walking Aid for Parkinson's Disease**
U. Delprato, R. Greenlaw, M. Cristaldi, et al. (Italy, UK, Germany)

17:00-17:15 **Telemedicine against Bioterrorism**
L. Baramidze, E. Kldiashvili, K. Gvetadze (Georgia)

17:15-17:30 **Health Gateway - A Complete Solution for Wireless Data Transfer and Follow-up of Patient Data**
A. Holopainen, F. Galbiati, K. Voutilainen (Finland)

Conference Program

Wednesday 5 April 2006 - 14:00-15:45

Conference Room 3

Tele-Education: A Must for Success

Chair: M. Healy

Co-Chair: O. Atkov

14:00-14:15 Tele-Education in Russia: Support Reform and Development of Health Delivery System
O. Atkov, V. Stolyar, N. Chueva et al. (Russia)

14:15-14:30 Ophthalmic Post-Graduate Teaching in Ireland: The Experience using Video-Conferencing and Collaborative Technologies
M. Healy, W. Power, D. Curtain, P. Mullaney (Ireland)

14:30-14:45 New Telemedicine Approach to Routine Sports Medicine Practicing with Mobile Tools
W. Glinkowski, A. Gorecki, M. Slotwinski (Poland)

14:45-15:00 Dissemination and Evaluation Tools for eHealth Products, Services and Distance Education
J. Zvarova, K. Zvara, P. Hanzlicek (Czech Republic)

15:00-15:15 Bulgaria and the First Academic Assisted Distance Education in Telemedicine
J. Vinarova, P. Pencheva (Bulgaria)

15:15-15:30 Telemedicine for Infection Control
K. Gvetadze, L. Baramidze, E. Kldiashvili (Georgia)

15:30-15:45 Telehealth Model between University and Primary Care
M.B. Moreira Alkmim (Brazil)

Wednesday 5 April 2006 - 16:30-17:30

Conference Room 3

IT Solutions in Healthcare (2)

Chair: R. Stevanovic

Co-Chair: S. Kolachalam

16:30-16:45 Purchasing Computer Program (Application) for Health
R. Stevanovic, I. Klapan, A. Stanic et al. (Croatia)

16:45-17:00 Progress of e-Health in Australia: OACIS (The Open Architecture Clinical Information System)
S. Kolachalam (Italy)

17:00-17:15 HEAL Framework: A Variation of SSM
S. Kolachalam (Italy)

17:15-17:30 Healthcare and Nutrition: Big Mother is Watching You
F. Buccolini (Italy)

Wednesday 5 April 2006 - 14:00-15:15

Conference Room 4

IT Solutions in Healthcare (1)

Chair: C. Gualano

Co-Chair: J.L. Cheng

14:00-14:15 Visual Communication for Healthcare
C. Gualano (Norway)

14:15-14:30 Reinforcement of Trans-theoretical Model on Exercise Behavior with Radio Frequency Identification Technology
J.L. Cheng, H.W. Liu, W.A. Hsieh, S.F. Huang (Taiwan)

14:30-14:45 Progress of e-Health in Australia: Health*Connect*
S. Kolachalam (Italy)

14:45-15:00 SSM Literature Review
S. Kolachalam (Italy)

15:00-15:15 Rural Telemedicine: Lessons from Alaska for Developing Regions
H.E. Hudson (USA)

Wednesday 5 April 2006 - 16:30-17:15

Conference Room 4

Community eHealth and Disease Surveillance

Chair: A.V. Vladzymyrskyy

Co-chair: A. Kollmann

16:30-16:45 Extracting, Storing and Viewing the Data from DICOM Files
L. Stanescu, D. Burdescu, A. Ion et al. (Romania)

16:45-17:00 A Telemedicine Framework for Collaborative Pacemakers Follow-up
A. Kollmann, D. Hayn, P. Kastner, et al. (Austria, Spain)

17:00-17:15 Classification for Methods of Telemedicine Efficiency Investigations
A.V. Vladzymyrskyy (Ukraine)

Wednesday 5 April 2006 - 14:30-17:30

Conference Room 5

Meeting of the EHTEL "Empowering the Citizen Task Force"

Closed Meeting

Thursday 6 April 2006 - 09:00-17:30

Conference Room 1

Séminaire CRP-Santé:

L'informatique au service du client-patient: nouvelles stratégies et solutions pour les hôpitaux, les caisses de maladie et l'industrie

09:00-09:10 Accueil et exposé officiel d'ouverture
Marie-Lise Lair, Directrice Centre d'Etudes en Santé, Centre de Recherche Public - Santé, Luxembourg

09:10-09:30 Le rôle de l'informatique santé pour la communication entre tous les acteurs: réalisations et projets à venir
Mars Di Bartolomeo, Ministre de la Santé, Luxembourg

Les nouvelles solutions informatiques: une séléction de huit solutions innovantes installées dans les hôpitaux et les caisses de maladie. Chaque business case présente une expérience pratique de mise en œuvre (business cases présentés en parallèle dans 2 salles):

Salle 1

09:30-10:00 Le dossier médical on line pour les médecins généralistes
L'expérience de l'Hôpital Gasthuiszuster - Antwerpen
Jean De Sitter, Directeur Informatique, Hôpital Gasthuiszuster, Belgique
Dominic Lemmens, Cegeka, Belgique

10:00-10:30 La prise de rendez-vous par internet à l'hôpital
L'expérience du Centre Hospitalier de Calais
Sylvia Delplanque, Directrice Informatique, Hôpital de Calais, France
Hugo Schellens, Ultragenda, Belgique

10:45-11:15 Les applications de télésurveillance au service du patient et du professionnel
Lionel Mommeja, IBM, Luxembourg

11:15-11:45 La gestion informatisée des workflows et des itinéraires cliniques du patient
L'expérience de la Clinique de la douleur à ZOL
Claude Van Coillie, YUSE, Belgique

Salle 2

09:30-10:00 L'intérêt du telemonitoring pour les maladies chroniques évolutives
L'expérience du Centre Hospitalier de Luxembourg
Daniel Wagner, CHL, Luxembourg

10:00-10:30 Le CRM et la gestion de la relation adhérents dans les mutuelles
Synthèse des expériences dans les mutuelles et les caisses de prévoyance et de maladie en France
Olivier Arnaud, Selligent, Belgique

10:45-11:15 **Suivi thérapeutique par le multimédia à l'Hôpital du Kirchberg**
Laurent Lury, Hôpital du Kirchberg, Luxembourg
Jean Racine, Telindus, Luxembourg

11:15-11:45 **Le suivi et la traçabilité des patients par les technologies RFID, Wi-Fi et Radiofréquence**
Michel Legrand, HICT, Belgique

11:45-12:15 **La place de l'informatique dans la stratégie marketing des hôpitaux de Genève**
Jean-Christophe Bretton, Directeur Général Adjoint, Hôpitaux de Genève, Suisse

14:00-14:30 **La mise en oeuvre d'un portail santé: nouvelle stratégie marketing vers les médecins généralistes et les patients? L'expérience de l'Hôpital St Jean à Bruges**
Helga De Neve, Directrice Informatique, Lauréate du prix e-gov 2005, Belgique

14:30-15:00 **Le client au centre des nouveaux projets informatiques des Mutualités Bénéfices et perspectives des chantiers en cours au sein de Patenamut et des Mutualités Libres**
Benoît Brassart, CIO, Partenamut, Belgique

15:15-15:45 **L'enjeu de la signature électronique et de Luxtrust pour le secteur de la santé**
M. Zimmer, Conseiller du Gouvernement, Luxembourg

15:45-16:30 **Comment accélérer et optimiser le déploiement de ces solutions performantes? Le point de vue de l'industrie, des autorités publiques, des caisses de maladie et des directions hospitalières**
Panel de tous les orateurs de la journée animé par François Daue, Optifa, Luxembourg

16:30-17:30 **Séance questions-réponses et conclusions**

Thursday 6 April 2006 - 09:30-10:30

Conference Room 2

Telecardiology
Chair: G. Varoneckas
Co-Chair: J. Pettersson

09:30-09:45 **Transtelephonic ECG, Different Approaches: The Aerotel Experience**
R. Schliesser (Israel)

09:45-10:00 **A Wireless PPG Sensor Applied over the Radial Artery - A Pilot Study**
J. Pettersson, L. G. Lindberg (Sweden)

10:00-10:15 **A Web-Based Data Bank of Heart Rate and Stroke Volume Recordings during Sleep**
G. Varoneckas, A. Martinkënas, A. Podlipskyte et al. (Lithuania)

10:15-10:30 **Distance Cardiology and Remote Psychology Care: Is this the Successful Formula?**
M. Jordanova, T. Dachev (Bulgaria)

Thursday 6 April 2006 - 11:00-12:30

Conference Room 2

eHealth in Developing Countries: The Future of Healthcare (1)
Chair: Y. Kwankam
Co-Chair: M. Zolfo

11:00-11:15 **Computer Skills and Digital Divide for HIV/AIDS Doctors in Low Resource Settings**
M. Zolfo, L. Lynen, V. Renggli et al. (Belgium, Peru)

11:15-11:30 **eHealth Program in Georgia**
E. Kldiashvili (Georgia)

11:30-11:45 **Telemedicine as a New Tool in Emergency Medical System of Uzbekistan**
B. Rahimov, A. Khadjibaev (Uzbekistan)

11:45-12:00 **Role of Telemedicine in Delivering Healthcare in Remote Areas of a Developing Country**
Z. Ahmed (Pakistan)

12:00-12:15 e-Health as a Tool to Improve Access to Health-Care Services in Developing Countries
L. Androuchko, V. Androuchko (Switzerland)

12:15-12:30 The Background on the Mobile Telemedicine Units Application in Telemedicine Services and Networks within the Outlying Regions
V.A. Drogovoz, V.M. Levanov (Russia)

Thursday 6 April 2006 - 14:00-15:30

Conference Room 2

eHealth in Developing Countries: The Future of Healthcare (2)

Chair: L. Androuchko

Co-Chair: N.P. Chowdhry

14:00-14:15 Design of Bluetooth-Based Low Cost Cardiac Telemonitoring System
N.P. Chowdhry, A.A. Memoni, B.S. Chowdhry, A.Q. Rjaput (Pakistan)

14:15-14:30 Exploring Natural Progression of Health-Related Uses of Mobile Phones: An Egyptian Case Study
P. Mechael (UK)

14:30-14:45 A Comparative Overview of e-Health Development in Developing and Developed Countries
P. Ray, L. Androuchko, V. Androuchko (Australia, Switzerland)

14:45-15:00 Establishment and Development of an Integral Information System: Four Croatian Innovations
R. Stevanovic, A. Stanic, I. Klapan et al. (Croatia)

15:00-15:15 Building Clinical Capacity in Africa: The Search for Cost Effective, Scalable Solutions
L. Firth (Australia)

15:15-15:30 On the Horns of a Dilemma: Telemedicine for Africa?
M. Mars (South Africa)

Thursday 6 April 2006 - 16:00-17:30

Conference Room 2

International Initiative for Ubiquitous Healthcare (u-Health)

Chair: M. Lee

Co-Chair: J.S. Lai

16:00-16:15 Welcome address
S.M. Hsu (Taiwan)

16:15-16:30 Intro to Ubiquitous Healthcare (u-Health) Consortium
P. Ray (Australia)

16:30-16:45 From eHealth to Pervasive Solutions and Ambient Intelligence in pHealth. An International Perspective with Examples from Cardiology
P. Rubel (France)

16:45-17:00 Asian Perspective: From e-Health to u-Health: NTUH Experience
F.P. Lai (Taiwan)

17:00-17:30 Panel Discussion
Moderator: P. Ray, S. Su
Panelists: M. Lee, F.P. Lai, S.M. Hsu, J.S. Lai, H.S. Chen

Thursday 6 April 2006 - 09:30-10:45

Conference Room 3

IT Solutions in Healthcare (3)

Chair: P. Zhang

Co-Chair: I. Bakettas

09:30-09:45 An Advanced Connectivity for Distributed and Heterogeneous Clinical Databases
I. Bakettas, C. Deimente, E. Gortzis, G. Nikiforidis (Greece)

09:45-10:00 CARAMEL: A Plugin-Architecture for the Secure Integration of Standards in Medical Information Systems
S. Brüggemann, M. Rohde (Germany)

10:00-10:15 Systematic Thinking in Multi-Agent System Coordination - Applied in Diabetic Health Care
P. Zhang, G. Bai (Sweden)

10:15-10:30 User Experience Design Guidelines for Telecare Services
B. von Niman, T. Sund, A. Rodriguez-Ascaso, S. Brown (France)

10:30-10:45 Mobile Phone Videoconferencing as a Tool for Rapid First Look Diagnosis
W. Glinkowski et al. (Poland)

Thursday 6 April 2006 - 11:00-12:15

Conference Room 3

Electronic Health Records and Data Transmission

Chair: T. Botsis

Co-Chair: T. Dostalova

11:00-11:15 Electronic Health Records in Continuous Shared Dental Care
T. Dostalova, P. Hanzlicek, Z. Teuberova et al. (Czech Republic)

11:15-11:30 Implementation of Computerized Information Systems in Oncology Unit
T. Botsis, P. Paraskeva, K.N. Syrigos (Greece)

11:30-11:45 Image Shark - PACS-CBIR Integrated System with Interactive Image Transmission using JPEG2000
P. Boninski, A. Przelaskowski, P. Halasa (Poland)

11:45-12:00 Seamlessly and Securely Sharing Health Care Data with Triple Space Communication
E. Dellavalle, D. Cerri, D. Cerizza, A. Ghioni (Italy)

12:00-12:15 Congestive Heart Failure (CHF) and Virtual Hypertension Clinic (VHC)
U. Korth, H. Schaps (Germany)

Thursday 6 April 2006 - 14:00-15:30

Conference Room 3

Doc@Hand Workshop

Knowledge Sharing and Decision Support for Healthcare Professionals

14:00-14:15 Project Description and Overview
A. Conconi (Italy)

14:15-14:30 Ethical e Security Issues
S. Pini (Italy)

14:30-14:45 Applying Doc@Hand to Support the Identification of Colon Cancer Patients at Primary Care Levels
A. Alonso (Spain)

14:45-15:00 Doc@Hand - The Answer to Patient Recruitment
K. Gyertson (UK)

15:00-15:15 Semantic Capabilities Brought by Doc@Hand
L. Sammartino (Italy)

15:15-15:30 ASP Model Validation
V. Bekiaris (Greece)

Thursday 6 April 2006 - 09:30-16:00

Conference Room 5

Healthware Workshop:

Improving Connectivity with Remote Areas for Equitable Access to Health Services

Chairs: Pascal Lochelongue (Alcatel Alenia Space) & Stephan Schug (EHTEL)

09:30-09:35 Presentation of the Expected Outcome of the Workshop
Pascal Lochelongue (Alcatel Alenia Space, Healthware Coordinator)

WELCOME ADDRESS:

09:35-09:45 Introduction of Healthware Context and Sitcom Policy of DG Enterprise
Christine Bernot (DG Enterprise)

09:45-09:55 Presentation of the Healthware Project
Pascal Lochelongue (Alcatel Alenia Space, Healthware Coordinator)

TELEMEDICINE IN EUROPE: STATEMENT AND EXAMPLES:

09:55-10:15 Presentation of ESA Telemedicine Study
Francesco Feliciani (Head of Applications Section, ESA/ESTEC)

10:15-10:35 UNESCO's Strategy and Priorities in Medical and Education Training
René Cluzel (DG Information, UNESCO)

10:35-10:55 Patients Point of View (Homecare/Telemedicine Solution for Retirement Home)
Angelica Frithiof (Stockholm Rheumatism Association, Sweden)

10:55-11:15 Insight and Experience Gained from Clinical Telemedicine Applications
Alexander Horsch (University of Tromso)

SPECIFICITIES OF HEALTHWARE PILOT SITES:

11:35-11:55 HEALTHWARE: A Telemedicine Statistics Focus and an Overview of the Users Needs
Bernard Comet (Centre National d'Etudes Spatiales (CNES), France)

11:55-12:15 Fast Track Option for Medical Training in BLS/ALS Using DVB-RCS in the Health Emergency Coordination Centre of Crete: A User-centered Approach
Dimitris Vourvahakis (Prehospital Emergency Coordination Center, Crete)

12:15-12:35 Cardiology/Oncology Network
N. Shastry (Bristol Royal Infirmary, UK)

12:35-12:55 Remote Medical [Primary] Care and Isolated Persons
Louis Lareng (CHU Toulouse, France)

HEALTHWARE USER AND CITIZEN OPEN GROUP:

14:00-14:15 Synthesis of the morning sessions with special emphasis on Healthware's specificities/particularities, introduction of the afternoon sessions
Stephan Schug (EHTEL)

14:15-14:35 Goal & Missions
Hélène Mignot (C2Team: Launch of the User and Citizen Open Group (UCOG))

ROUND TABLE/OPEN DISCUSSION:

14:35-15:45 What is the expected added value of telemedicine applications (economical impact, medical practice, citizens and patients concerns), how to converge to an operational model? Definition and development of generic solution?
Stephan Schug (EHTEL) & Pascal Lochelongue (Alcatel Alenia Space, Healthware Coordinator)

DGInfso, European Community, e-Health and European Social Cohesion Policy
TBC

Evidence on Economic Impact of eHealth and Telemedicine Applications
Alexander Dobrev (Empirica, Germany)
Francesco Feliciani (ESA/ESTEC)
N. Shastry (Bristol Royal Infirmary)

15:45-16:00 Recommendations, Conclusion and Overview
Pascal Lochelongue & Stephan Schug

Friday 7 April 2006 - 09:30-10:30

Conference Room 1

International Telemedicine and eHealth Initiatives and Developments (1)

Presented by the International Society for Telemedicine & eHealth (ISfTeH)

Chair: M. Nerlich

Co-Chairs: A. Giannone, E. Kldiashvili

09:30-09:45 **P.O.CA.HO.N.T.AS (Point Of CAre HOme Networked Tele ASsistance) An example of hospitalization in the territory**
A. Giannone, V. La Bella, F. Paone (Italy)

09:45-10:00 **Telemedicine workstation for Developing Countries**
J.B. Fortuin Abrahams, M. Molefi (South Africa)

10:00-10:15 **Healthcare Systems Transformation - the role of eHealth**
R.J. Richardson (UK)

10:15-10:30 **The Creation of a National Telemedicine/eHealth Association in Nigeria and its Impact on the Federal Ministry of Health ICT-Committee**
O.J. Awolola, B.L. Lawson (Nigeria)

Friday 7 April 2006 - 11:00-12:30

Conference Room 1

International Telemedicine and eHealth Initiatives and Developments (2)

Presented by the International Society for Telemedicine & eHealth (ISfTeH)

Chair: R. Richardson

Co-Chair: W. Glinkowski

11:00-11:15 **Virtual Health Care Knowledge Center in Georgia**
E. Kldiashvili, N.G. Shakulashvili (Georgia)

11:15-11:30 **Tele-Virtual Reality and Tele-3D-Computer Assisted Surgery in Croatia: The Newest Telemedicine Technologies of the 21st Century**
I. Klapan, R. Stevanovic, M. Novosel et al. (Croatia)

11:30-11:45 **Internet-based tele-rehabilitation videoconferencing system**
W. Glinkowski, K. Makosa, M. Wasilewska, et al. (Poland)

11:45-12:00 **Telemedicine Developments: A Regional Consorted Action in the INTERREG IIIC Program**
P.J.M.M. Epping, R. Pullen, A. Wagener et al. (The Netherlands, UK, Italy, Spain)

12:00-12:15 **New Ways in telemedicine - Experience of 2005**
A. Vladzymyrskyy, V. Klymovytskyy, E. Dorokhova et al. (Ukraine, Netherlands, Switzerland)

12:15-12:30 **IT in Healthcare of Developing Countries: Moldovan Experience**
A. Grimut, C. Jaloba, M. Bortnic, V. Jeltonogov (Moldova)

Friday 7 April 2006 - 13:00-14:40

Conference Room 1

Space Technology as a Tool for Delivery of eHealth

Under coordination of the United Nations Office for Outer Space Affairs (UNOOSA)

Chair: M. del Mar Lleo

Co-Chair: A. Lee, F.D. Balducci

13:00-13:10 Introduction to the session "Space Technology as a Tool for eHealth": Use of Satellites to Face Environmental Threats to Human Health, and Use of Satellites in Telemedicine

13:10-13:25 Satellite-based Health Early Warning for Environmental Risks
M. del Mar Lleo (Italy)

13:25-13:40 Strategy Towards Sustainable Services in Tele-Health and Tele-Epidemiology
M. Lafaye, A. Guell (France)

13:40-13:55 Space Technology to Manage Control Interventions and Surveillance of Vector-Borne Diseases: National Control Program of Chagas Disease: Spatial Identification of Infested Houses Notified by Communities under Entomological Surveillance using GPS Technology to Monitor and Define Areas under Risk of Re-infestation
G. Russomando (Paraguay)

13:55-14:10 Development of a Portable Telemedicine Station
F.D. Balducci (Argentina)

14:10-14:25 Telemedicine Applications in Mobile Surgery
E.B. Rodas, F. Mora, F. Tamariz, A. Vicuna, R.C. Merrell, E. Rodas (Ecuador, USA)

14:25-14:40 River Health: Description of an Integral Healthcare Program in a Remote River Basin of Ecuador
E.B. Rodas, F. Mora, F. Tamariz, A. Vicuna, R.C. Merrell, E. Rodas (Ecuador, USA)

Friday 7 April 2006 - 09:30-10:30

Conference Room 2

Homecare and Health Management (2)

Chair: G. Perolle

Co-Chair: Th. Vontetsianos

09:30-09:45 A Programmable Multimedia Homecare Assistant
S. Ionita, M.M. Ionita (Romania)

09:45-10:00 Automatic Fall Detection and Activity Monitoring for Elderly
G. Perolle, P. Fraisse, M. Mavros, I. Etxeberria (Spain, France, Greece)

10:00-10:15 Home-Based Integrated Care in Patients with Chronic Respiratory Failure with the Use of E-Health Services
Th. Vontetsianos, P. Giovas, A. Rigopoulou et al. (Greece)

10:15-10:30 Luxembourg Heart Failure Project, A New Concept of Tele-Homemonitoring for CHF Patients
N. Roesch (Luxembourg)

Friday 7 April 2006 - 11:00-12:00

Conference Room 2

Homecare and Health Management (3)

Chair: L. Gadda

Co-Chair: T. Jokinen

11:00-11:15 Telecare - Practical Experiences with Video Communication in Homecare
T. Pfeller, E. Huber, B. van Venrooij (Austria, The Netherlands)

11:15-11:30 A Multichannel Communication Platform for Healthcare: Case Studies
T. Jokinen (Finland)

11:30-11:45 A Semantic-Based Healthcare Information Infrastructure Able to Integrate Medical Information and eHealth Services
E. Dellavalle, V. Perdoni, L. Gadda (Italy)

11:45-12:00 Telehomecare in PALLIATION Study (TIPS): Real Time Videoconferencing Support for End of Life Care
T. Abernathy, R. Cohen, C. Goldsmith et al. (A. MacLennan) (Canada)

Friday 7 April 2006 - 13:00-14:00

Conference Room 2

Making Better Healthcare Service Best: Healthcare Challenges

Chair: R. Stevanovic

Co-Chair: P. Ray

13:00-13:15 Towards a Global e-Health Framework for the Support of Pandemic Control
S. Hinske, P. Ray (Germany, Australia)

13:15-13:30 Nine-Year Experience in Telemedicine for Rural and Remote Districts of Russia: From Teleconsultations to e-Diagnostic Centers
O. Atkov, V. Stolyar, A. Selkov (Russia)

13:30-13:45 Telemedicine Segment of the Croatian e-Health System
M. Novosel, I. Klapan, R. Stevanovic, A. Pavelin, N. Klapan, M. Katic (Croatia)

13:45-14:00 TBC
Y. Kwankam (Switzerland)

Friday 7 April 2006 - 09:30-10:30

Conference Room 3

How to Harness the Power of Internet for Competitive Health Care

Chair: P.D.F.A. Fullarton

Co-Chair: H.S. Chen

09:30-09:45 A Global, Low Operational Cost and Zero Infrastructure Investment, Store and Forward Telemedicine Platform
P.D.F.A. Fullarton (South Korea)

09:45-10:00 Application of VoIP Technology with Mobile Health Information System in a Wireless Hospital
H.S. Chen, C.E. Tai, G. Lee et al. (Taiwan)

10:00-10:15 CLINIC (Collaborative pLatform for supportINg knowledge management processes In the healthCare sector)
V. Perdoni (UK)

10:15-10:30 International Law and Telemedicine
N. Devillier (France)

Friday 7 April 2006 - 14:00-16:00

Conference Room 4

Board Meeting

International Society for Telemedicine & eHealth (ISfTeH)

Closed Meeting

Friday 7 April 2006 - 09:30-16:00

Conference Room 5

Consortium Meeting

Healthware Project

Closed Meeting

"Global Healthcare Challenges and Opportunities: The Role of Advanced Technology"

TATRC Symposium ✦ 5 April 2006

- **Opening/Keynote**
  Greg T. Mogel, MD
- **Broadband Medical Networks**
  Ms. Mary Kratz
- **Mobile Health Care Solutions**
  Mr. Tommy Morris
- **Operational Standards**
  David Lam, MD
- **Deployed TMED Technologies**
  COL Ron Poropatich
- **Virtual Reality**
  Brenda Widerhold, PHD, MBA
- **Environmental Sensors Development**
  Kevin Montgomery, PHD
- **International Activities/Closing**
  Jean-Louis Belard, MD, PHD

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Exhibitors

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website: www.aerotel.com

Aerotel is one of the world's leading manufacturers of modular, mobile telemedicine devices designed for physicians, outpatient clinics, diagnostic and emergency service providers. Aerotel leads the market in cost-effectiveness. Its high quality, user-friendly, compact systems ensure optimal performance and maximum reliability for continuous, long-term monitoring.

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Allgeier Computer NV

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With the "Medical Viewer" solution, a state of the art solution from Allgeier Computer installed in many Belgian and Dutch hospitals, all patient information is digitized and stored centrally on a server or on near-line storage devices. Access to the information is available for everyone for all types of documents (protocols, invoices, note, clinical reports, external reports, ...) The Medical Viewer can be easily integrated with all hospital applications and communication protocols.

Cardiocom Multi-Disease Management

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Cardiocom is the leader in biometric monitoring solutions for CHF, diabetes, COPD, asthma, and obesity. Cardiocom allows you to remotely monitor your patient's vital signs, symptoms, and compliance. Cardiocom provides in-house software tools or outsource population management solutions. Cardiocom's advanced biometric monitoring system improves your patient's quality of life, reduces hospitalizations and enables cost-effective management. Cardiocom is a vertically integrated manufacturer providing telehealth products since 1997 with a nationwide client base. Cardiocom received the "Best Enabling Tool for Disease Management" from the DMAA in 2004 and 2002. Cardiocome was awarded the "Most Innovative Technology to Improve Patient Outcomes" at the Emerging Technologies and Healthcare Innovation Congress.

CASCOM

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CASCOM is a STREP project (FP6-511632) of the EU IST Programme. The main objective of CASCOM (Context-aware Business Application Service Co-ordination in Mobile Computing Environments) is to implement, validate and trial a value added supportive infrastructure for semantic web based business application services across mobile and fixed networks. The essential approach is the innovative inter-disciplinary combination of intelligent agent, semantic web, P2P, and mobile computing technology. At Med-e-Tel 2006, this project is represented by its partner Universidad Rey Juan Carlos from Spain.

Cegeka Healthcare Systems

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Cegeka designs, develops and implements software solutions for the healthcare sector (hospitals and clinicians-specialists) such as medical record, patient care plans, electronic drug prescription, nursing plans and clinical pathways. Cegeka also provides a broad package of ICT services, such as software development, operations activities, help desk, hosting, disaster recovery... to mainly Belgian customers. The services are offered in the form of outsourcing or service contracts on a project or temporary basis.

COCOON

c/o MIP - Consorzio per l'Innovazione nella Gestione della Impresa e della Pubblica Amministrazione
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website: www.cocoon-health.com

Presenting the right knowledge to the right medical professional in the right place and at the right time is of paramount importance in making critical medical decisions. Driven by this paradigm, COCOON, a European Community funded research project, concerns the development of a knowledge-based approach to diagnostic and therapeutic risk management.
COCOON is a 6th Framework EU project aimed at setting up a semantics-based healthcare information infrastructure with the goal of reducing medical errors. To this end, COCOON offers a set of Web services to support medical decision for risk management, along with a method for gluing them together through semantics with existing healthcare services from external providers.

Exhibitors

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The Centre de Recherche Public de la Santé (Public Research Centre for Health, abbreviated as CRP-Santé) is a public institution of a scientific and technological nature which is run under the dual supervision of the Ministry for the Arts, Higher Education and Research, and the Ministry of Health.

As its R&D responsibilities range from fundamental biology to public health, the scope of activities of the CRP-Santé covers fundamental, applied, clinical and public health research, for which it must ensure a dynamic and continuous development of the expertise.

DOC@HAND

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In the Healthcare area there is an increasing need of sharing and accessing clinical information: such a scenario determines a massive phenomenon of data sharing and retrieval among multiple actors and multiple organizations. Doc@Hand gives an opportunity for integration and communication in a wide set of data such as clinical records, guidelines, clinical cases, protocols, scientific publications, corporate news, diseases correlated information; it aims to support Healthcare professionals in their day-by-day activities bridging the gap between patient's related data and unstructured information, providing a platform able to easily access to heterogeneous and geographically dispersed information, allowing to query the system using natural language query.

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eHIT Ltd specialises in wireless eHealth and well-being solutions that provide intuitive and flexible approach to remote care such as home care, self care and occupational health.

We have a strong background in seamlessly integrating different measurement devices into various information systems. Leveraging our in-depth knowledge of healthcare processes together with our expertise in latest mobile and wireless technologies we can provide unique eHealth solutions to improve today's disease management environment.

European Health Telematics Association (EHTEL)

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The European Health Telematics Association ("EHTEL"), provides to its members a platform for information lobbying, representation, networking and co-operation in support of the implementation of information and communication technologies (ICT) in health and social care in Europe.

EHTEL believes that using ICTs in health and social care in Europe offers an unparalleled opportunity to revolutionize:

- The quality of health and social care services provided to patients and citizens
- The speed and ease of access to those services; and
- Their efficiency and cost effectiveness.

The association brings together under one roof all of the constituencies with an interest in ICTs in health and social care: national and regional health authorities and systems, hospitals and other health institutions, public and private insurance providers, health professionals, health managers and executives, patients, citizens and consumers, industry, researcher and academics, national and regional member-based organizations.

European Association of Healthcare IT Managers (EAHITM)

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website: www.eahitm.org

EAHITM is outlined as the pan-European umbrella association of all relevant national healthcare IT associations in Europe. Believing in the fundamental importance of unifying healthcare IT professionals at European and global levels, the mission of EAHITM is: to establish common healthcare IT standards, policies and strategies at EU and international levels; to increase the visibility, importance and role of IT management in healthcare facilities; to educate key policy makers, industry players and the general public of the benefits of healthcare IT, and to promote the cross-collaboration of various healthcare sectors.

For more information on EAHITM, contact Karmin Ruocco, Project Director, at k.ruocco.pd@eahitm.org.

Exhibitors

European Commission

Directorate-General Information Society
Unit H1 - ICT for Health **tel: +32 2 296 6949**
BU31, rue de la Loi 200 **fax: +32 2 296 0181**
1049 Brussels ***e-mail: ehealth@cec.eu.int***
Belgium ***website: http://europa.eu.int/information_society/activities/health/index_en.htm***

The ICT for Health Unit is based in the European Commission, Directorate-General for Information Society and Media - as part of a Directorate that focuses on ICT for Citizens and Business. Its mission is to contribute to better health status and well-being of all European citizens, to bring economic and productivity benefits to the health systems of all Member States, and to stimulate the sustainability and growth of the eHealth industry in Europe. The driving vision of the Unit is the concept of an ICT-enabled citizen centred health delivery system, with special emphasis on prevention and personalisation. It does this through co-financing research and technology development in intelligent environments that enable ubiquitous management of citizens' health status and assist health professionals in coping with major health challenges. It also has a policy orientation, and is the initiator of the eHealth action plan - an ambitious plan to make health care better for all Europe's citizens through the provision of eHealth.

To pick up useful European Commission, and ICT for Health-related information, please visit the exhibition stand at Med-e-Tel.

Healthware

c/o Alcatel Alenia Space **tel: +33 4 92 92 6123**
contact: Pascal Lochelongue **fax: +33 4 92 92 7760**
e-mail: pascal.lochelongue@alcatelaleniaspace.com
website: http://healthware.alcasat.net

HEALTHWARE is the major telemedicine via satellite project on a European scale, over the next few years. The European Commission has entrusted ALCATEL ALENIA SPACE with the coordination of this project within the context of the European Union's 6th Framework Program (Aeronautics & Space - 2004).

HEALTHWARE's purpose is to contribute to the development of telemedicine use and solutions via satellite, especially based on DVB-RCS technologies (star or mesh). DVB-RCS guarantees high speed transmission capacity from any medical institution (hospital, clinic, retirement home, dispensary, etc.) and offers new possibilities for high interactivity applications (tele-expertise, surgical video-assistance, etc.).

Healthware addresses 4 fields of medical activity dealing with chronic respiratory illnesses as well as cardiac and oncological diseases: Medical training, Teleconsultation, Second opinion, Home services.

Through the HEALTHWARE project, ALCATEL ALENIA SPACE is coordinating a consortium of 19 partners including industrial, operators, engineering companies as well as health care professionals and academics in Italy, Greece, Cyprus, the United Kingdom, Poland and the Czech Republic.

HICT NV

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HICT nv is an independent Belgian company offering industry specific solutions and services to the extended Healthcare market place (care providers, patients, suppliers, public sector related services, 3rd payers, etc.).

HICT's vision is that Healthcare-specific Information, Communication and Technology solutions can bring measurable added value to this industry.

HICT's mission is offering the Healthcare market place consulting, software development and integration services based on Healthcare specific value propositions, with the objective to raise the service level and quality of care for the patients and their relations and to optimize the resources for the healthcare providers.

HICT believes that through further re-engineering, automation, innovation and integration of healthcare resources and stakeholders, we can assist to raise the level of service and quality in favor of the patient, and optimize the use of the available resources of the healthcare providers.

HICT has the ambition to become a European player in Healthcare Consulting and ICT.

Honeywell HomMed

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USA

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website: www.hommed.com

Honeywell HomMed® concentrates its expertise on remote patient monitoring with over 21,000 patient units installed worldwide. It's been involved in the care of over 350,000 patients. The monitors and software are hospital grade FDA Class II medical devices. In addition to base biometric measurements, multiple peripheral devices can also be attached. User health data is automatically color coded and triaged for quick review.

Using voice commands and light cues the MedPartner™ Medication Reminder prompts users when it's time to take medication, the prescribed amount, appropriate bottle and if the wrong medication is selected.

Exhibitors

IBM Belgium sa

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tel: +352 360 385 323
website: www.ibm.com/be
website: www.ibm.com/industries/healthcare
contact: Christophe Martin

Why IBM for healthcare and life sciences?

Today's healthcare industry is under pressure to reduce clinical and administrative costs and meet tighter compliance and security mandates. IBM provides the technology, services, consulting and e-business experience you need to meet those demands and realise new opportunities in the ever-changing healthcare environment.

A pioneer in healthcare information technology, IBM remains at the forefront of improving how healthcare organisations deliver efficient, high quality care. IBM, in combination with our global network of business partners and strategic alliances, delivers powerful business technology and comprehensive services that help your healthcare organisation achieve success.

IBM is helping clients manage an explosion of data. Accelerate discovery and development. Reduce costs. Respond to compliance and security mandates. Improve diagnoses and patient care.

How can we help you?

IEM GmbH

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website: www.iem.de

IEM, a very sound German company, has established itself a world-wide reputation of superior quality with its products and is the only company that supplies support by way of its customer relation management software to optimise compliance and therapy success. Meanwhile, the products enjoy also world-wide reputation as outstanding marketing and research tools.

I.R.I.S. Luxembourg

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I.R.I.S. Luxembourg, filiale du groupe I.R.I.S. dont le siège est situé en Belgique, est une société de services établie à Luxembourg spécialisée depuis de nombreuses années dans l'intégration et la mise en place de solutions complètes de Gestion Electronique de Documents, de Gestion de Contenu, d'Infrastructure et de Gestion de l'espace de stockage.

Notre expertise couvre les domaines d'activités suivants: Paper & Data Capture, Document and Content Management, Workflow Management, Enterprise Report Management (Cold), Web Content Management, Digital Asset Management, e-collaboration and messaging, Portal and e-Business Applications, System & Storage Management.

ISfTeH - International Society for Telemedicine & eHealth

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The International Society for Telemedicine & eHealth (ISfTeH) exists to facilitate the international dissemination of knowledge and experience in Telemedicine and eHealth, to provide access to recognised experts in the field worldwide, and to offer unprecedented networking opportunities to the international Telemedicine and eHealth community.

Contact us to find out how we can help you or how you can share your Telemedicine and eHealth experience with the world.

Visit our stand at Med-e-Tel to obtain more information about the ISfTeH, about upcoming conferences, and about the following events and ISfTeH national and institutional member organizations:

IITEC Intensive Interdisciplinary Telemedicine and eHealth Course	(*www.iitec.org*)
Colombian Telemedicine Center	(*www.colombiantelemed.org*)
Danish Society for Clinical Telemedicine	(*www.e-health.dk*)
Finnish Society of Telemedicine	(*www.fimnet.fi/telemedicine*)
Georgian Telemedicine Union	(*http://georgia.telepathology.org*)
Institute of Tropical Medicine, Antwerp, Belgium	(*http://telemedicine.itg.be*)
Medical Research Council, South Africa	(*www.mrc.ac.za/telemedicine/telemedicine.htm*)
Polish Telemedicine Association	(*www.amwaw.edu.pl/pttm*)
Sociedad Venezolana de Telemedicina & eHealth	(*www.telemedvenezuela.org*)
Society for Medical Informatics of Bosnia & Herzegovina	(*www.imasic.org/bhsmi*)
Society for Telemedicine and eHealth in Nigeria	(*www.sftehin.org*)

Also various other ISfTeH partners and members will be represented on the ISfTeH exhibition stand and in the ISfTeH conference sessions at Med-e-Tel on Friday 7 April.

Exhibitors

MAPPED

c/o British Maritime Technology
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website: http://services.txt.it/MAPPED

The MAPPED project aims to provide disabled users with the ability to plan excursions from any point to any other point, at any time, using public transport, their own vehicle, walking, or using a wheelchair, taking into consideration all their accessibility needs. In addition to this, MAPPED aims to provide the users with location-based services tailored to their accessibility needs.

MAPPED is a project co-funded under the IST 6th Framework Program of the European Commission, and it started on the 1st of September 2004. The duration is 36 months.

Medixine Ltd

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Medixine Ltd specialises in communication solutions for Disease Management. Our solutions are Internet-based and independent of terminals and disease. We combine expertise in health care, software technology and Internet services to e-enable health care and wellness industries. Medixine has over 10 years of experience in e-health and e-care solutions.

We follow the latest trends in measurement device and client terminal technologies to provide horizontal top of the line communication solutions that enhance any disease management program.

Melexis Connectivity Solutions

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Since Melexis Netherlands was established as the Dutch development centre of Melexis NV, we have focused on delivering the right machine-2-machine (M2M) technology for the problems faced by our clients. Our M2M-technology has proven itself in the field with an impressive 20.000 installations sold in the field of telemedicine. Having proven the technology, Melexis Connectivity Solutions in 2005 was ready to leave the technology incubation from Melexis NV and become an independent technology solution provider. Since then we have been developing compelling business cases for the technology in the medical and energy markets. For additional information, please visit www.melexis.nl.

Noesis

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website: www.noesis-eu.org

NOESIS is an Integrated Project (IP), part-funded by the European Commission within the Information Society Technology (IST) programme. The main goal of the project is the design and implementation of an innovative tool for medical information retrieval that mediates medical decision and prognosis of critical health conditions.

NOESIS will provide healthcare professionals with a new powerful decision support framework, and a new, innovative way of searching information through a dynamic knowledge management system, reducing time and effort often spent on searching information with currently available tools.

The project started in January 2004 and will be completed by the end of December 2006.

Omron Healthcare Europe

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OMRON HEALTHCARE EUROPE B.V. is OMRON's healthcare division for Europe, the Middle East and Africa. Its aim is to support the health and well-being of its customers by providing innovative medical technologies and products for Monitoring and Therapy. The product range of OMRON HEALTHCARE EUROPE B.V. includes blood pressure monitors, respiratory therapy products, electronic fever thermometers, massage devices, body fat monitors and others. Omron can offer Telemedicine solutions to provide Medical Professionals and Pharmaceutical Companies possibilities to send data of important and accurate medical parameters on a simple way to any server, platform, or address. For additional information, please visit www.omron-healthcare.com.

Pharmionic Systems

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Pharmionic Systems together with AARDEX provide electronic monitoring of patients with prescribed drugs. Date and time of pill container openings (MEMS^{7}) are electronically stamped in the container's cap and then transferred to a centralised database for analysis. This technology together with our database of more than 16,000 patients enable to provide customised intervention programmes to improve compliance and persistence based on the actual drug intake history of patients. We have 18 years experience in studying patient exposure to drug regimens and its clinical correlates.

Exhibitors

Selligent Belux

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Selligent is an international company specialising in high-performance sales, marketing and customer service solutions.

The success encountered by the Selligent solutions amongst their 50,000 users can be attributed to appropriate customer coaching during implementation and to the extremely flexible configuration features of the advanced web technology used. These two components guarantee a quick return on investment, a high user adoption rate and a reduced total cost of ownership.

Telemedicine and Advanced Technology Research Center (TATRC/MRMC)

USAMRMC-ZB-T
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The Telemedicine and Advanced Technology Research Center (TATRC), a subordinate element of the United States Army Research and Materiel Command (USAMRMC), is charged with managing core Research Development Test and Evaluation (RDT&E) and congressionally mandated projects in telemedicine and advanced medical technologies. To support its research and development efforts, TATRC maintains a productive mix of partnerships with federal, academic, and commercial organizations. TATRC also provides short duration, technical support (as directed) to federal and defense agencies; develops, evaluates, and demonstrates new technologies and concepts; and conducts market surveillance with a focus on leveraging emerging technologies in healthcare and healthcare support. Ultimately, TATRC's activities strive to make medical care and services more accessible to soldiers, sailors, marines, and airmen; reduce costs, and enhance the overall quality of military healthcare.

If you have any questions please contact: Ms. Lori DeBernardis, Director of Marketing and Public Affairs, phone: +1 301 619 7927, e-mail: debernardis@tatrc.org.

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For 25 years now, Telindus S.A. has been offering its services in the Grand Duchy of Luxembourg. In the field of telecommunications as well as in the field of information systems. Nowadays Telindus Luxembourg employs no less than 300 people and operates 4 legal entities and brands: Telindus, networking and system; Telectronics, specialized in installation and maintenance of computer and electronic equipment; Telindus PSF offers advisory services and sourcing services in the financial sector; Computer Home dedicates itself to retail selling.

Telindus is active in the healthcare sector with specific solutions adapted to the customer's needs.

Telindus S.A. Luxembourg is a part of Telindus Group NV which is an international ICT company offering network-based solutions, meeting business and public-sector needs. Telindus serves these markets as a solution & sourcing partner, delivering secure multimedia network solutions, underpinned by management and support services. Telindus is present in 14 countries including Western Europe, Hungary, Israel, China and Thailand and has an international team of 2400 employees.

u-Health

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website: www.ehealthcom.org/uhealth.htm

Ubiquitous Healthcare (u-Health) focuses on e-Health applications that can provide healthcare to people anywhere at anytime using broadband and wireless mobile technologies. A new international collaborative initiative conceived as part of the future activities of IEEE Healthcom, which brings together academia and industry, healthcare and information technology professionals to facilitate interdisciplinary collaborations for the development of humanity's future good.

This initiative is intended to demonstrate how collaboration between countries can lead to successful u-health applications. It may be noted that the world's increasing ageing population necessitates concentrated research on healthcare paradigms beyond the current hospital-based healthcare regime because the hospitals (which are already stretched to limits) will not be able to handle the increase in ageing population. In addition, the increasing percentage of chronic illnesses requires a pervasive effort to increase the awareness of all concerned on how to lead a healthy life.

National Taiwan University (NTU), one of the initiators of the initiative, being the first integrated and most prestigious institution of higher education, has taken up the responsibility of promoting the level of academic research study and teaching in Taiwan. In particular, NTU medical informatics focuses on research areas in e-learning, e-health, mobile computing, and ubiquitous healthcare.

Exhibitors

UltraGenda

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UltraGenda offers web-native IT solutions to support specific processes in the hospital which have a huge impact on efficiency and are insufficiently addressed by existing systems. Our best-of-breed solutions address the following:

- enterprise-wide appointment scheduling
- direct bookings by referring physicians and patients
- bed planning
- patient transport

In these fields, UltraGenda offers everything you would expect from a leader: vision, robust and rich applications, superb technology, ease of use, impeccable service. The various components of the product suite can be implemented separately. They all integrate easily with existing HIS systems.

Every single day, our generic solutions are proven by an enthusiast customer base, consisting of some 100 leading hospital sites across Europe. UltraGenda Pro, our enterprise-wide appointment scheduling system for example handles some 25 million appointments per year.

Thanks to UltraGenda, the healthcare community can increase efficiency and introduce e-business concepts that have transformed other sectors of the economy.

Viterion TeleHealthcare

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Viterion® TeleHealthcare, a Bayer-Panasonic company, offers versatile solutions for remote patient monitoring. Viterion TeleHealthcare brings together Bayer's commitment and knowledge of healthcare and Panasonic's technical expertise, to develop and market telehealth products. Viterion's telehealth solutions include remote patient monitoring and disease education for wellness monitoring, chronic disease management and post-acute home care. Viterion's solutions are designed to significantly reduce hospital stays and emergent care, and to empower and engage patients in their own care.

Using Viterion's telehealth technology, healthcare providers can interact with their remote-location patients as often as necessary, and implement a structured, customizable regimen to match each patient's individual needs. Viterion TeleHealthcare monitors use highly reliable store-and-forward technology. Easy and convenient network access for providers is provided via the Internet.

Wireless Matters Ltd

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Wireless Matters is based in The Innovation Centre at the University of Hertfordshire home of the new Bedfordshire and Hertfordshire Postgraduate Medical School. Through our core product CareTeam™, we focus on using wireless technologies to enable home and mobile healthcare services. CareTeam™ integrates wireless monitoring devices, rich internet applications and services that enable multi-disciplinary teams and family members to collaborate across a virtual environment to deliver individualised monitoring and support to patients outside of dedicated care facilities.

YUSE

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YUSE is an innovating health care company. In cooperation with important people in the medicine world, Yuse develops practically-oriented solutions. Thanks to the Matrix Box, YUSE is able to automate a patient's complete health care course, from the first consultation till the end of the treatment. YUSE also defines and implements - with the help hospital staff - the change management that is necessary to improve the quality of patient care, of its effectiveness and working conditions.

Our vision: These days, hospital computerization is mostly done based on individual initiative and departmental initiative. The most effective approach to computerize hospital processes is nevertheless taking the patient's course as a red thread. From the first hospitalization, or first line health care until release from the hospital and the follow-up after release.

Our mission: YUSE proposes a total and multidisciplinary solution to the hospital world, that integrates all internal and external care processes. A modular system that can possibly also be linked to existing applications.

The YUSE Matrix Box assures:

- Optimizing and improvement of health care quality
- A more effective organization, planning and administration
- A real and proven profitability

Exhibitors

Poster Display under Coordination of the United Nations Office for Outer Space Affairs (UNOOSA): Space Technology as a Tool for Delivery of e-Health - Space Technology-Based Telehealth Project Initiatives in Developing Countries

TELEMEDICINE: A PUBLIC HEALTH SERVICE IN REMOTE, ISOLATE AREAS

Development of a Portable Telemedicine Station
Fernando D. Balducci
Coordinador Grupo de Telemedicina, Facultad de Bioingenieria, Universidad Nacional de Entre Rios, Argentina

Telemedicine in mobile surgery
Edgar Rodas
Universidad del Azuay, Ecuador; Cinterandes Foundation (www.cinterandes.org), USA

River health: description of an integral healthcare program in a remote river basin in Ecuador.
Edgar Rodas
Universidad del Azuay, Ecuador; Cinterandes Foundation (www.cinterandes.org), USA

The National Tele-health Program in Mexico
Amanda Gomez, Marcela Ramirez, Alberto Villagomez, Erik Garcia
Mexico

Cube-Sat solution proposal for the lack of a permanent satellite channel for telemedicine purposes in the American Region
Lilia Edith Aparicio[1], Juan Carlos Narvaez[2]
[1] Telemedicine Director, Distrital University (www.udistrital.edu.co), Colombia
[2] Civil Aviation of Colombia (www.aerocivil.gov.co), Focal Point of the Fourth Space Conference of the Americas, Colombia

Pilot Project of Social Connectivity for the formation and development of local capacities by more and better health in countryside and small localities of the Argentine territory under communication platforms (the SAT/WiMAN-WiLAN/PC)
Miguel Guillaumet, Marcelo Petrich
Argentina

Evaluation of video educative material for patients: a pilot scheme in 12 public health facilities of South Africa
M. Kachienga, S. Wynchank, M. Moretlo, S. Olorunju
Medical Research Council (www.mrc.ac.za), South Africa

MEDES: Application of satellites in ehealth
M. Bernat, R. Rettig, L. Braak
MEDES (www.medes.fr), Institut de Medecine et de Physiologie Spatiales, France

Space technology for telemedicine in extreme environments and disaster response
S.W. Cone, A. Rafiq, R.S. Hummel, R.C. Merrell
MITAC (www.meditac.com), NASA Research Partnership Center, Virginia Commonwealth University, USA

SATELLITES AND GPS/GIS TO MANAGE CONTROL INTERVENTIONS AND SURVEILLANCE OF VECTOR-BORNE DISEASES

National Control Program of Chagas Disease: Spatial identification of infested houses notified by communities under entomological surveillance using GPS technology to monitor and define areas under risk of re-infestation
Graciela Russomando
Ministerio de Salud Publica y Bienestar Social, Servicio Nacional de Control de Vectores (SENEPA), Paraguay

Integral evaluation of malaria in Tuntunani (Bolivia) at 3800 m o/s
Aparicio Effen Marilyn, Aparicio James, Rodriguez Jaime, Lima Edwin, Arana Ivar, Chavez Rimort, Halborsen Kjetil
Programa Nacional de Cambios Climaticos, Ministerio de Planificacion del Desarrollo (www.mds.gov.bo), Bolivia

The remote sensing perspective to focus landscape ecology, the anthropogenic action and the malaria disease
L. Delgado, S. Ramos
Laboratorio Sistemas de Información Modelaje Ecológico Ambiental (SIMEA), Universidad Central de Venezuela, Venezuela

EWS TO PREDICT AND PREVENT ENVIRONMENT-RELATED INFECTIOUS DISEASES

Remote sensing to Predict and Alert on the Risk of Waterborne Disease Outbreaks
Cristina Rodriguez1, Maria del Mar Lleo2 and Christian Haag1
1Departamento de Oceanografía, Mariscope Chilena, Chile
2Dipartimento di Patologia, Sezione di Microbiologia, Università di Verona (www.medicina.univr.it), Italy

Remote sensing-GIS to predict on the risk of eutrophycation in reservoirs
Claudia Rodriguez, Matias Bonansea, Florencia Bonatto, Viviana Reynoso, Carlos Prosperi[2], Miguel Mancini, Claudia Ledesma[1]
[1] Matematica y Biestadistica, Universidad Nacional de Rio Cuarto, Argentina
[2] Diversidad Vegetal I., Universidad Nacional de Córdoba, Argentina

Satellite imaging applied to epidemiology: the experience of the Gulich Institute in Argentina
C.M. Scavuzzo, M.A. Lamfri, C. Rotela, X. Porcasi, E. Estallo
Instituto Mario Gulich, Comisión Nacional de Actividades Espaciales (www.conae.gov.ar), Argentina

uHealth

International Initiative for Ubiquitous Healthcare

u –Health Taiwan

Ubiquitous Healthcare (u-Health) focuses on cutting-edge IT applications that can provide healthcare to people anywhere at anytime using broadband and wireless mobile technologies. A new international collaborative initiative of u-Health which conceived as part of the future activities of IEEE Healthcom brings together academia and industry healthcare and information technology professionals to facilitate interdisciplinary collaborations for the development of humanity's future good.

HealthCom2007 In Taiwan

HealthCom 2006 will be held in New Delhi, India, with the theme of "ITU-D Mobile E-health Initiative for Developing Countries". And HealthCom 2007 will be held in Taipei, Taiwan, with the expected theme of "Ageing population drives much of the e-health research in the developed world that is expected to have two old persons for every young person in the year 2050. This has led to the new drive on u-health in the developed world."

Contact

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National Science Council , Taiwan

National Taiwan University , Taiwan

http://www.ehealthcom.org http://www.healthcom2006.org http://www.uhealth.tw

Media Partners

ArabMedicare.com

www.arabmedicare.com

Established in 1999, ArabMedicare.com is a regional web portal aimed at healthcare professionals from government, business, and academia with over 1.8 million visitors per year from over 120 countries. Providing Market Intelligence Services (Arab healthcare market), Accredited Online Continuing Medical Education Courses, Medical News Syndication Services, Consultancy on Arab Healthcare market.

Editer Instrumental Médico

www.editermedical.com

Equipment, supplies, accessories and hospital services guide and website (in Spanish and English) of products and manufacturers, events, health institutions, and more.

European Hospital

www.european-hospital.com

European Hospital points at trends and developments in the European healthcare market. From business strategies and hi-end development in medical technology; IT solutions or innovative approaches in logistics, personnel, finance and management. Hospital administrators, medical directors and senior staff in 34 European countries turn to European Hospital for in-depth coverage of the healthcare market.

Federal Telemedicine News

www.federaltelemedicine.com

An online publication that goes to healthcare professionals, corporate executives, college and university directors, academic medical centers, researchers, hospital administrators, and others in the field that need up to the minute data on telemedicine, telehealth, and health information technology activities in the U.S. Federal Government, Universities, and State governments.

Healthcare IT Management

www.eahitm.org

Healthcare IT Management is the official voice of the European Association of Healthcare IT Managers (EAHITM). Management and best-practices driven, the publication is devoted to supporting the goals of EAHITM and providing a central communications platform for key stakeholders in the healthcare IT sector.

Media Partners

Healthcare IT News

www.healthcareitnews.com

Healthcare IT News is the news source for healthcare information technology, published by MedTech Publishing Company in partnership with HIMSS. Healthcare IT News publishes a monthly newspaper, weekly e-newsletter, and daily online news service that deliver industry news, data and analysis in tight stories that appeal to busy readers.

Hospital Healthcare Europe

www.campden.com

Produced in association with HOPE, Hospital Healthcare Europe is the essential resource for European hospital healthcare professionals with over 130 informed articles and case studies, individual sections on facilities management, IT and communications, laboratories, radiology and imaging, theatre and surgery, clinical care, nursing and patient care, pharmacy and therapeutics.

Hospital Post

www.hospital-post.com

Hospital Post is GIT VERLAG's bi-monthly publication for decision makers in European hospitals - with a circulation of 25,000 copies, from Lisbon to Minsk, and from Oslo to Palermo. It provides a forum to opinion leaders in all healthcare-related fields and covers the major hot issues in medical technology, IT, general management, facility management, and clinical diagnostics.

i4d

www.i4donline.net

The i4d (Information For Development) magazine is intended to provide a much-needed platform for exchange of information, ideas, and experiences, both inside and outside the Information and Communication Technology for Development (ICT4D) sector. i4d encompasses the role and relevance of ICT in various development sectors such as Rural Development, Education, Health, Wireless Communication, ICT For Poor.

IHE - International Hospital Equipment & Solutions

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www.radcliffe-oxford.com

Informatics in Primary Care aims to provide information, help and guidance to all those concerned with information technology and management in primary care, both nationally and internationally. The journal seeks material for both researchers and practitioners in the field of primary care informatics, ranging from scientific papers, through editorials and case studies, to websites, useful tools, reviews and conferences.

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www.informationfortomorrow.com

Information For Tomorrow specializes in home telehealthcare tools and applications. We have produced more than one dozen informational reports that identify key developments underway in the home telehealthcare arena. Home telemedicine-related projects we've completed include focuses on chronic disease patient management with emphases on diabetes, heart disease, and needed tools for home care tele-delivery.

International Journal of Health Information Systems and Informatics

www.idea-group.com/ijhisi

International Journal of Healthcare Information Systems & Informatics (IJHISI) is a quarterly, peer-reviewed scholarly journal, published by Idea Group Publishing. Advancing technologies from management perspective on the one hand and their applications in clinical settings on the other hand will drive interests in IJHISI.

IST Results

www.cordis.lu/ist/results

IST Results is an online editorial service reporting on research results and ongoing activities of projects funded under the European Commission's IST programme. The service covers a wide range of Information and Communication Technologies, including e-health, telemedicine as well as other medical ICT applications and innovations.

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Journal of Telemedicine and Telecare

www.rsmpress.co.uk/jtt.htm

The Journal of Telemedicine and Telecare is widely regarded as the leading journal in the field. Published 8 times per year, the journal includes an editorial leader, conference diary, news, technology updates, research tutorials, reports from various telemedicine organizations, peer-reviewed papers, review articles, original articles, editorial commentary, preliminary communications, case reports and letters to the editor.

Management & Krankenhaus

www. management-krankenhaus.de

Management & Krankenhaus addresses 43,000 decision makers in German hospitals each month. Themes covered range from medical technology, IT, general management, facility management, to clinical diagnostics. Readers include leading medics, IT, technical, and facility managers, head administrative staff, and laboratory directors.

MedTech Business Review

www.campden.com

MedTech Business Review is an information resource for everyone concerned with the medical technology industry in Europe and around the world. It focuses on all aspects of innovative medical device/technology financing, manufacture, marketing and usage in all healthcare sectors, with a comprehensive mix of expert overviews and in-depth analyses of emerging technologies, market conditions and opportunities.

Technology and Health Care

www.iospress.nl

Technology and Health Care is the Official Journal of the European Society for Engineering and Medicine, published by IOS Press, an international STM publishing house of books and journals in a wide range of fields, including medical science, artificial intelligence, rehabilitation, physics and computer science.

Telemedicine and e-Health

www.liebertpub.com/tmj

Telemedicine and e-Health is a leading international, peer-reviewed journal combining medicine, telecommunications, and information technology. This journal publishes authoritative empirical research, descriptive case studies, policy analysis, and technical design, including technical requirements, clinical protocols, data formats, and communication protocols for telemedicine systems, as well as case reports.

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Telemedicine Information Exchange - TIE

http://tie.telemed.org

TIE, the Telemedicine Information Exchange, has provided comprehensive telemedicine information on the web since 1995. The TIE is widely regarded as one of the best online resources for telemedicine information for healthcare professionals, researchers, government agency staff and the general public.

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Ukrainian Journal of Telemedicine and Medical Telematics

www.telemed.org.ua

The Ukrainian Journal of Telemedicine and Medical Telematics is published by the Department of Medical Informatics and Telemedicine of Donetsk R&D Institute of Traumatology and Orthopedy. Main subjects of the journal are: telemedicine, medical telematics, medical and clinical computer science, IT in medical research and education, statistical research and simulation in medicine, medical cybernetics and medical equipment.

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VMW - Virtual Medical Worlds

www.hoise.com/vmw

Virtual Medical Worlds is a monthly Virtual Magazine on Telemedicine and High Performance Computing and Networking for readers interested in computer applications in medical environments. VMW is produced by an editorial team composed of professionals in publishing, and an advisory board with professionals in telemedicine, providing the embedding into the everyday practice and research.

Abstracts

A COMPARATIVE OVERVIEW OF E-HEALTH DEVELOPMENT IN DEVELOPING AND DEVELOPED COUNTRIES

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There have been substantial developments on e-Health in the developed world to reach healthcare to remote communities, such as the outback in Australia and the Alaska region in North America. e-Health has the potential to alleviate, to some extent, the problems of healthcare due to the ageing population and increasing percentage of chronic patients that require close attention.

Telemedicine services may be perceived as more of a necessity in developing countries than they are in the developed countries, resulting in a greater willingness among the former to change established methods of doctor-patient interaction and healthcare administration. ITU-D Question 14 (telecommunication for healthcare) has been looking at this problem since 1995 and it has analyzed the introduction of e-Health services in many developing countries. The findings present some compelling case for the need for telecommunication for healthcare in view of the following:

- These countries suffer from a severe shortage of healthcare professionals
- The population living in rural areas suffers from the lack (or absence) of healthcare
- High maternal and prenatal mortality rate (as high as 30% in some cases)
- Very few doctors (particularly in rural and remote areas) have access to medical journals after graduation
- Most hospitals and healthcare centers have a poor telecommunication infrastructure

IEEE Communication Society sponsors an annual event called Healthcom to discuss these issues. The success of Healthcom has led to the recent IEEE/ITU-D Mobile e-Health initiative for developing countries. This initiative currently involves twenty countries and efforts are underway to trial a range of mobile e-Health architectures for addressing a range of e-Health problems (e.g., disasters like Tsunami and pandemics like bird flu) in developing countries. This initiative is now growing with the support of World Health Organisation (WHO) that has given a high priority to e-Health in its efforts to reach healthcare to citizens located in remote communities.

This paper provides a comparative overview of worldwide development of e-Health in developed and developing countries based on the experience of the authors in leadership roles of international initiatives led by the ITU-D and the IEEE Communication Society. The presentation will draw from the deliberations at IEEE Healthcom over last several years on these issues.

Keywords: e-Health, telemedicine, developing countries and m-health

A GLOBAL, LOW OPERATIONAL COST AND ZERO INFRASTRUCTURE INVESTMENT, STORE AND FORWARD TELEMEDICINE PLATFORM

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Store and forward Telemedicine systems have now been with us for some time. The ITC technologies upon which they are based are very mature now but the need for a low cost/no cost store and forward Telemedicine platform remains largely, unaddressed.

Even in the remotest areas of the world, communications infrastructure is developing rapidly leveraging such technologies as VSAT satellite communication and GSM as well as cable and fibre delivering ever increasing bandwidth. The key issue for most agencies now that the technology is becoming more generally available is the investment required to establish their own Telemedicine network.

To date, most 'commercial' Telemedicine systems have been developed and operated by consortia and alliances of one form or another and are provided as tools to their membership or employees. These 'systems' typically force users (medical practitioners) to work within bounds of reference defined by their management organizations and are not openly accessible to all comers.

The need exists for a Telemedicine platform that allows the users of the system to forge their own referral networks over a common platform. On this sits a human network of medical professionals that uses a system akin to an EMAIL application or service with which to communicate. This service must securely route CASE PACKAGES in a 'structured' and 'managed' fashion to other registered network

users or groups of users, as defined by the initiating user. The results/outcomes of a referral/second opinion request would then be routed back via the same path.

i-MED.NET is a new Telemedicine system and service, launched recently, that addresses all of the above issues. In addition, the design terms of reference called for:

- A functionally rich and advanced store and forward client platform, applicable to many medical disciplines that incorporate all the necessary functionality within one application
- A platform that does NOT require any specialised hardware and software components, leveraging off-the-shelf computers, imaging devices and operating systems
- A platform that supports a pool of imaging devices through a broad range of industry standard interfaces
- An application interface that is very user friendly, simple to learn and intuitive
- Zero server platform investment for users or user communities
- Zero communications infrastructure investment other than 'standard', consumer level Internet connectivity for users or user communities
- A client platform that is very low cost to operate
- A system that leverages the public internet as its communications backbone but one that offers very high levels of security and patient confidentiality
- A platform that is PORTABLE – a solution that works equally well when disconnected from the network and one that automatically synchronises when network access is available.

i-MED.NET came online in Nov. 2005 and has achieved all of the design goals mentioned here.

Keywords: Telemedicine, Store and Forward, Internet

A HOME CARE SYSTEM USED IN POST-OPERATIVE PATIENT MANAGEMENT

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The scheme described in this paper presents a home care system used in the eTEN-project INTERLIFE (www.interlife-project.net) and based on the technological development of the CHS project. INTERLIFE provides an innovative model of healthcare services based on a technologically assisted early discharge procedure and a continuous home monitoring service. Technological objectives concern the development of new generation telemedicine services and the integration of telematics technologies, data acquisition devices, educational material interfaces, data security and data fusion. Healthcare-based objectives address cost effectiveness and citizen involvement in health care delivery, as well as opportunities for better diagnosis to the clinical staff.

Following these objectives, a home care system has been designed that combines initial screening, measurement devices, patient education, decision support, appropriate telephone/WAP/WWW contacts and physician access. The system architecture follows a 3-tier model. Three different technologies have been chosen exemplary for the patient interfaces, so that patients may choose the communication means of their preference: Computer Telephony: Fully automated telephone Contact Center, Wireless Technology: WAP, WLAN/GPRS, Internet

The system was tested in three different clinical trials for the management of diabetes, congestive heart failure and post trauma patients.

In the case of the post trauma trial, after surgical intervention patients are trained in operating the home care unit (Tablet PC with WLAN/GPRS network connection) and instructed to their treatment plan and medication. After early discharge, essential data about the clinical status of each patient are obtained through a personalized questionnaire on a daily basis. A home care agency provides wound documentation. The relevant patient data is sent to the clinical unit using GPRS technology. The surgeon can remotely monitor the postoperative course, which allows precise documentation of the healing process and quality assurance.

The current system was developed, following the hypothesis that individualized telemonitoring, patient education and self-care empowerment can substantially reduce the length of hospital care without compromising medical safety and outcomes. Multiple means of communication are offered, thus a high ration of the patient population can be included. This increases patients' involve-

ment in their own health, and hopefully reduces the need for hospitalization. Furthermore, the personal profiles, customized to user's needs, contribute to customization of health care delivery. The system is flexible, allowing incorporation of new communication technologies, such as UMTS, with little development effort, thus serving the idea of an integrated system for health care delivery.

Keywords: home monitoring service, patient education, ubiquitous computing

A MULTICHANNEL COMMUNICATION PLATFORM FOR HEALTHCARE: CASE STUDIES

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To be able to cope with the multitude of needs in today's challenging communication environment, a communication system for disease management should be able to: (a) support all terminals in wide use (b) provide a horizontal approach as opposed to distinct vertical solutions (c) have open and flexible interfaces for integration. In a project started in 2000 a communication solution has been developed in Finland with these goals in mind. The end result is a system with a layered architecture, an optimised application server supporting software modules for specific communication tasks. Modules have been developed for instance for handling of e-booking, collecting home measurement results from patients, different questionnaires and queries, peer-to-peer support, safe messaging etc. On top of the modules a solution layer allows for xml configuring of solution specific features. A specific solution always fulfils the three basic requirements listed above.

The communication solution has now been used in close to 50 installations in Finland, Norway, United Kingdom, France and the United States. We will present a selection of projects:

1) Medication Management

Helsinki City Home Healthcare, implementation for 400 patients including an automatic drug dispenser capable of sending messages to server, reminders as automatic voice phone calls

2) Treatment and medication follow-up

Turku University Hospital, implementation for the department of surgery. Automatic treatment follow-up questionnaires to patients with reminders, multichannel support for answering.

3) Multiplayer e-booking

Tampere University Hospital Central Laboratory. E-booking for local hospitals, healthcare centers and directly to patients. Received the Millenium Technology Honorary Award in 2005.

4) Asthma self management solution

A major UK company's pilot for 30 asthma patients in occupational healthcare. Wireless uploading of spirometer values through mobile phones, mobile symptom and medication questionnaires, mobile reports. Reminders as SMS messages to patients.

5) RFID Communication board

The Finnish Alzheimer Society's pilot to provide easy structured messaging to early phase Alzheimer patients.

6) Parkinson's Disease Support Network

A comprehensive e-service for Parkinson's patients, their families and professional caretakers in Surrey, England. Evaluated by Imperial College.

Keywords: e-health, communication, e-booking, home measurements, questionnaires, RFID, chronic disease, disease management.

A PROGRAMMABLE MULTIMEDIA HOMECARE ASSISTANT

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The issue of telemedicine integration into routine medical practice is very promising by the idea addressing the concept of programmable multimedia homecare assistant. This is to extend the current concept of patient terminal that is one of the most challenging parts. The idea is to create a standard platform for the in-house patient terminal fusing different available technologies and services.

This study is mainly based on the family doctor practice, which create the opportunities for a various medical services. Many tasks in current practice of a family doctor are focused on chronic cases with one or more diseases like arterial hypertension, coronary heart disease, cerebral vascular accident, chronic renal insufficiency, diabetes mellitus, as well as heart rhythm disorder. Generally, the doctors have to prescribe the complex schema of treatment as well as the specific hygiene-dietetics recommendations. Usually, a lot of information should be communicat-

ed to the patient regarding the treatment administration and additional medical advises related on the side effects, precautions, and alternate medication. An important complementary part of doctor-patient communication also consists in the information about the ill and suffering. A tremendous counseling work should be done by doctors in order to make aware the patient about his or her sickness and disorders, determining him or her to adopt an adequate particular life style. The doctors perform all these spending a lot of effort writing prescriptions in associations with more or less oral detailed explanations and often repetitive and chronophague.

Our contribution is focused on the development of a friendly user multimedia programmable unit as a personal healthcare assistant, 24 hours a day accessible by chronic patients. The concept implements a particular homecare service in order to bring and maintain closely the doctor and chronic patient between the regular consultations. Under these circumstances, a dedicated programmable architecture was designed to perform the followings: advertising/alerting of the patient on his daily-prescribed drugs, advising of the patient about his specific hygiene-dietetics recommendation, vital signs monitoring in order to adapt the treatment. This design also supports an extension for Internet connection. In addition, the unit will be capable to show the short video clips on medical instructions and educational contents. The programmable unit is an open architecture based on a core processor that manages a voice and acoustic signaling module, a display and visual signaling module, a data storage and programming module, a data input module for medical monitoring devices and an Internet-based communication module.

We expect to a high efficiency of this unit for the family doctors with more than 1,500 of patients from which the chronics are over 25%. Technically speaking we think the unit is a useful terminal for eHealth and homecare applications addressed especially to the elder patients. In this stage of development, this unit is not considered as an interface between doctor and patient but rather a mean to increase the doctor's assistance by his virtual presence that provides the medical recommendations and can repeat untiringly any information are required. The next step towards an Intelligent Personal Health Assistant is to extend the unit with an advanced expert system.

Keywords: Personal Health Assistant, Homecare applications, eHealth, Programmable unit

A SEMANTIC-BASED HEALTHCARE INFORMATION INFRASTRUCTURE ABLE TO INTEGRATE MEDICAL INFORMATION AND EHEALTH SERVICES

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Presenting the right knowledge to the right medical personnel in the right place and at the right time is of paramount importance in making critical medical decision. Driven by this paradigm, COCOON (IST-2002-507126), a European Community funded research project, concerns the development of a knowledge-based approach to diagnostic and therapeutic risk management.

COCOON is a semantics-based healthcare information infrastructure designed to offer interactive support to general practitioners and healthcare professionals, assist them to efficiently handle complex medical cases, such that diagnosis and treatment errors are minimized, potentially saving lives and the rising costs of healthcare and malpractice suits. Providing infrastructure for proficient knowledge sharing and transfer, this approach can significantly improve knowledge driven collaborative practices among healthcare communities in Europe and provide a test bed for similar efforts elsewhere.

The services at General Practitioners' disposal through COCOON Platform are:

– Decision Support System (DSS)

  DSS interacts with the patient record and provides clinical guidelines in an interactive form, factually guiding a General Practitioner's decision making during his/her interaction with a specific patient;

– Semantic Information Retrieval (SIR)

  Semantic Information Retrieval utilizes ontology engineering for concept indexing of free text documents, in order to provide relevant medical publications from multiple, distributed content sources;

– Advice Support

COCOON supports Healthcare Professionals in finding the most appropriate group of experts to ask for an advice. Once the group of experts has been identified, the involved actors can exchange information and share data via COCOON multi-channel collaborative work platform. The results of the work sessions might be indexed using COCOON ontology and stored for a future use. Advice tool describes CoPs, access to system modalities, sustainability etc. The Advice service input are mainly General Practitioners and other HC providers that are involved in offering and receiving services from peers. In this case, there are two usage cases.

The aim of the paper will be to describe the case study of Lombardy Region. This region is one of the COCOON project pilot where the first COCOON prototype will be deployed. The description of the case study consist in identifying the general contest and analyse the selection of General Practitioners (GP)/specialist that will test the platform.

Keywords: risk management, Semantic Web Services and semantic information retrieval, medical decision support, clinical guidelines

A TELEMEDICINE FRAMEWORK FOR COLLABORATIVE PACEMAKER FOLLOW-UP

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Pacemaker (PM) implantation is only the first step in the therapy of patients suffering from several heart rhythm diseases. Subsequently, PM have to be inspected up to four times a year in special cardiology centres. In the course of these follow-ups mainly the depletion level of the battery, the basic function of the PM, and patients' general conditions are assessed and documented.

According to international standards each PM reacts to the application of a permanent magnet by changing the pacing rate in a predefined way depending on the depletion level of the battery and on the type of the PM ("magnet effect"). Therefore, a routine two channel ECG recording can be used to verify whether the PM works correctly or if further examination is indicated.

The general idea of this project has been to shift a significant number of PM follow-ups from follow-up centers to caregivers located in the patients' vicinity, based on the fact, that "basic follow-ups" can be performed without the necessity of manufacturer specific PM programming devices. However, this requires an increased level of communication and collaboration between the physician at the point-of-care (rural hospitals or primary care physician) and the cardiologist at the PM clinic.

In the course of this project a telemedicine framework for manufacturer independent remote pacemaker follow-up has been developed and evaluated in a clinical trial. 24 consecutive patients (age 75 +/- 13 years, 17 different PM models from 6 different manufacturers) have been registered to the PM follow-up system. In advance of the standard PM follow-up procedure a two-channel ECG was recorded during magnet application using a mobile, PDA-based ECG recording system. Specially developed software running on the PDA guided the physician through the data acquisition process and triggered data transmission to the remote monitoring centre via a UMTS network. At the monitoring centre the ECG was processed and the magnet effect was analysed automatically. Finally, the results ("OK", "not OK", or "UNDEFINED") were sent to the physician via SMS.

The system was able to identify 17 out of 24 PM as "OK". While the standard follow-up procedure classified all 24 cases as "OK" seven cases were classified as "UNDEFINED" by our system. Further analysis showed that – under some conditions – the sampling rate of 256Hz of the ECG recording system was to low to identify the pacing spikes consistently.

Nevertheless, the results indicate that the presented follow-up concept has the potential to work as an efficient screening method and may spare a significant number of patients the burden of having to travel to specialized hospitals. In case of detected PM malfunction or undefined PM status the patient would be sent to the special PM clinic for further examination immediately. Additionally, the use of a central electronic patient record has the potential to improve PM therapy with respect to documentation and quality management.

Keywords: Telemedicine, Pacemaker Follow-Up, ECG, UMTS

A WEB-BASED DATA BANK OF HEART RATE AND STROKE VOLUME RECORDINGS DURING SLEEP

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Heart rate variability is widely used in clinical medicine as a diagnostic tool and as a prognostic marker for coronary artery disease. Many of sophisticated heart rate variability analysis methods are used including classic techniques and novel methods based on statistical physics and nonlinear dynamics such as approximate entropy and detrended fluctuation analysis. The need for quantitative evaluation and comparison of analysis methods is evident. It might be solved by the use of new created databases consisting integrity and reliability of raw data from recorded physiological signals which provides facilities for the cooperative analysis of data and the evaluation of proposed new algorithms.

The goal of the study was the development of a public Web-based DataBank of heart rate and stroke volume physiological signals and related data for use by the scientific research community.

DataBank is a large and growing archive of well-characterized digital recordings of physiologic signals of cardiovascular system and related data for use by the biomedical research community. DataBank currently includes 3 following databases: time series of interbeat (RR) interval, time series of stroke volume (SV) values and related data. Additional data include sleep stage coding and personal information of investigated subject. These databases include physiologic signals in each recording that may be freely downloaded. The brief tutorial followed by pointers on downloading data and information about the archives themselves are presented. The lengths of these records vary, but average about 7-8 hours each. DataBank currently occupies about 9 gigabytes and is growing. DataBank currently includes databases of cardiovascular signals and other biomedical data from 50 healthy subjects and 750 patients with a variety of conditions such as coronary heart disease, congestive heart failure, premature beats, atrial fibrillation, sleep apnea, and aging. Apnea – DataBank consists of 274 RR interval recordings, each typically 8 hours long, with accompanying sleep apnea annotations obtained from polysomnographic study of simultaneously recorded respiration signals and is accompanied by a manually-scored hypnogram. Free electronic access to DataBank via the World Wide Web (*http://www.pri.kmu.lt/datbank/*) is provided.

Conclusions: Developed web-based DataBank offers free access via the web to large collections of recorded physiologic signals for scientific researchers and intend to foster interaction among investigators from many different disciplines; for a broad audience, including basic scientists, mathematicians, engineers, clinicians, and students working in biomedical sciences and related technologies.

Keywords: web-based data bank, heart rate, stroke volume, sleep.

A WIRELESS PPG SENSOR APPLIED OVER THE RADIAL ARTERY – A PILOT STUDY

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Photoplethysmography (PPG) is a well-known non-invasive technique in the medical field. It is mainly used for monitoring skin perfusion and oxygen saturation. PPG measures changes in intensity of light that has been emitted into the skin and reflected or transmitted towards a photodetector. There is no exact knowledge of the mechanisms behind the PPG signal but it has been suggested that the pulsatile component is related both to pulsatile volume changes due to varying lumen of the vessel and to red cell orientation during each cardiac cycle.

A specially designed wireless PPG sensor has been developed for application over the radial artery to gain centrally related blood flow variables. A study was performed to assess the relationship between the PPG signal and several physiological parameters. Recordings were made using an arrangement of a Doppler ultrasound probe, a non-invasive blood pressure measuring device (Portapres), impedance measuring device that records respiration work and a wireless PPG measuring device attached over the radial artery. All signals were recorded simultaneously and analyzed afterwards.

The measurements showed a close relationship between the recorded variables. The strongest correlation was found between pulsatile PPG and blood velocity (measured by Doppler ultrasound).

This correlation was most obvious during hyperventilation. In this case there was also a strong correlation between PPG and blood pressure measured by Portapres. The recordings also showed that deep respiration could be observed both by PPG and Portapres.

In conclusion;

- the PPG signal may reflect blood pressure variations as well as a velocity-related component in a bigger vessel
- respiratory events may be observed in the radial artery using PPG

Keywords: Blood pressure, Blood velocity, Non-invasive, Photoplethysmography

AN ADVANCED CONNECTIVITY FOR DISTRIBUTED AND HETEROGENEOUS CLINICAL DATABASES

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In medicine a clinical entity is usually represented by different synonymous keywords, meaning that physicians are dealing with a rapidly changing, unstructured and qualitatively heterogeneous data sharing environment while trying to pick up the needed information of decision-making. In recent years, ontologies have been adopted in many scientific communities as a way to share, re-use and process domain knowledge by using a variety of formats including RDF(S), OWL, and XML Schema's. However current systems cannot satisfy the new desiderata of Medical Information Systems, such as the demand for re-use and sharing patient's data, their transmission and the need of semantic-based criteria in order to reduce the "noise" of less relevant medical information. The aim of this work is both to review fundamental theoretical issues in ontology and propose a scenario for a grid of collaborative Medical Information System by using metadata databases combined with multi-tier architecture and eXtensible Markup Language. The proposed infrastructure may promote integration and multimedia data exchange amongst heterogeneous nodes of medical grid environment. This dynamic design is associated to schema descriptions maintained in catalogues and medical repository entries, providing information about both stored data and healthcare department's processes associated with them.

Keywords: Ontology, Collaborative, Metadata, XML

HEALTHCARE PROFESSIONALS – AN INNOVATIVE WEB-BASED ONTOLOGY DRIVEN INFORMATION ACCESS PLATFORM

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In Healthcare field there is an increasing need of sharing and accessing clinical information: such scenario determines a massive phenomenon of data sharing and retrieval among multiple actors and multiple organizations. Doc@Hand gives an opportunity for integration and communication in a wide set of data such as clinical records, guidelines, clinical cases, protocols, scientific publications corporate news, diseases correlated information; it aims to support Healthcare professionals in their day-by-day activities bridging the gap between patient's related data and unstructured information, providing a platform able to easily access to heterogeneous and geographically dispersed information, allowing to query the system using natural language. In addiction, Information and Knowledge found can be displayed thanks to an intuitive interface able to easily filtering and navigating such information.

This would significantly enhance the ability of doctors to exploit this integrated information for more effective and cost-effective decision-making. One of the key feature of the platform is then an advanced semantic capability brought by the adoption of Ontologies (Top, Middle and Domain Level), a natural language parser and a powerful xml-based search engine, automatically leading to a dramatically increase of search results relevance.

These features are provided by Semantic Subsystem, a set of modules strictly interoperating each other mainly focused to provide Information and Knowledge retrieval (clinical records, guidelines, etc) and Information Management (document submission, content parsing, knowledge mark-up, concepts extraction, etc.).

Doc@Hand is the first integrated healthcare software system to implement a combined content push,

query pull and user profiling approach that is centred around individual users; it is able to create and keep up to date the user profile (user interests, last queries, last actions, etc...) and, thanks to the adoption of push technologies, can automatically provide a lot of user-profile relevant information without the need for the user to perform an explicit query.

Access to Doc@Hand can be made through different terminals, such as desktop, laptop, tablet, pda etc. to support the increasing mobility of Healthcare professionals, and will be validated by major clinical institutions for full adherence to standards and regulations for security and sensitive data handling.

Platform architecture is modular and based on Web Services in order to provide a real distributed and multiplatform environment (content server); it works as a central node of a network of organisations, sharing their repositories or parts of them, according to a predefined set of rules and policies. Information is structured in XML standard, in order to optimize the communication and the compatibility among modules.

The platform will be validated in two real world applications (consortium End User partners): HCPB (Hospital Clinic de Barcelona, Spain) will use it to support the screening and management of the colon cancer screening, whilst GST (Guy and St.Thomas Hospital, UK) will use it to suggest to the doctor all the available multiple myeloma trials suitable for a given patient, to maximise the chances for each patient to be matched to all available trials without requiring encyclopaedic knowledge by the Healthcare professional.

Keywords: eHealth, ontology, natural language processing, push technology.

AN APPROACH TO TELEMEDICINE/EHEALTH INTERNATIONAL STRUCTURES AND INITIATIVES

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The rapid developments of Information and Communication Technologies (ICT) together with achievements in Space Research are changing the way how people give and receive health care. All who use the ICT and Space Research for health-related purposes – patients, health care professionals, administrators, etc. – must join together, also at international level, to enhance the utilization of these achievements for meeting health care needs. The aim of this presentation is to outline the Telemedicine/ eHealth action territory and to draft an initial inventory of existing international structures and initiatives in the field. Attention will also be paid to the necessity of networking in understanding, developing and implementing eHealth. It is a global challenge to making several different types of industries and activities to optimally coordinate their skills and efforts to reach the ultimate goal: delivering best possible health service for anyone, at any time, anywhere!

Keywords: eHealth, action territory

APPLICATION OF VOIP TECHNOLOGY WITH MOBILE HEALTH INFORMATION SYSTEM IN A WIRELESS HOSPITAL

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National Taiwan University (NTU) medical campus area includes NTU college of Medicine and its affiliated hospital has established the wireless network service. This service is available not only to NTU hospital personnel but also to NTU faculty, students and the general public. The general public can surf the Internet websites. NTU faculty and students can log in with the computer center account or College of Medicine email account to surf the Internet or Intranet websites, send and receive emails and transfer files. This ubiquitous network communication setting enables NTU hospital to become a wireless medical center.

During the process of healthcare, medical personnel and other paramedical personnel need pretty frequent communication and interaction. Traditional communication ways include telephones, pagers, broadcasting and conference discussion. However, due to transportation advancement and demands of mobilization, the transformation of health system starts to focus on interaction and the sharing of medical information among medical centers, community hospitals, and primary care physicians to

provide in-time, ubiquitous and comprehensive healthcare. The use of wireless communication and multimedia sharing communication technology can improve interpersonal communication and the efficiency of sharing medical information will promote the quality of healthcare effectively.

NTU hospital has collaborated with Intel Corporation launching a pilot project and applied Voice over Internet Protocol (VoIP) technology integrated with conventional telecommunication network into healthcare environment. 100 users have been involved in this project, including doctors, nurses, and residents of family medicine department, doctors and nurses of resuscitation team, doctors and medical technologists of laboratory medicine department, and all interns rotated to pediatrics department. Internet protocol-based telecommunication equipments including universal serial bus(USB) telephones, wireless fidelity (WiFi) phones and personal digital assistant (PDA) phones to make voice calls, broadcasting and conference calls and also integrate traditional telephone and mobile phone networks to converse or hold meetings with inside hospital, branch hospital extension phones and outside area through telephone or mobile phones bidirectional. Moreover, as for providing handheld device and notebook with mobile capability, it can integrate health information including electronic medical records, laboratory reports, PACS, decision support system. The preliminary result of user survey revealed high need of health information inquiry and low accessibility of computer facility. Most of the users show high expectation and positive attitude to mobile health information system.

In the future, we hope to further develop application combining radio frequency identification (RFID), mobile medical facilities and application of video conferences under structure of instant messaging and information sharing platform.

Keywords: VoIP technology, Internet, wireless network, mobile health information system

APPLICATIONS OF SATELLITES IN EHEALTH

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MEDES, the French Institute for Space Physiology and Medicine, is an economic group of interest created in 1989, with missions are to develop space medicine and applications of space research in health. MEDES provides support for space and biomedical engineering, to develop applications in health and to carry out clinical research programmes.

In the field of eHealth, satellites offer several relevant services:

- Access to communication in remote areas or mobiles, including broadband and multicast services
- Localisation
- Remote sensing

Theses services can be applied in several applications sectors, as described hereafter.

Distance education

In this domain, satellites offer access to broadband and multicast telecommunication capabilities. The availability of interactive television technologies enables to provide educational services “at home”, for instance for patients with chronic diseases.

Teleconsultation

Satellites offer access to telecommunication in remote areas, mobiles, and in disaster situations, enabling to provide distant access to medical expertise. Operational telemedicine networks have been implemented in remote areas, like Guyana. Demonstrations have been made for disaster medicine and an operational system is under development.

Environmental epidemiology

Satellites provide access to communication for electronic epidemiological surveillance, and remote sensing data enabling to develop predictive models of environmental related diseases. Several electronic surveillance networks have been successfully implemented, for instance in Senegal, Niger and Burkina Faso, or are under development, for instance in South America.

Medical assistance

In this domain, satellites provide access to communication and localisation. Linked with technologies of smart clothes, these services enable to develop services for ambulatory monitoring and assistance to persons.

In these different applications fields, MEDES develops the projects in co-operation with research and healthcare organisations, industries, service providers, space agencies, and is open to new partnership.

Keywords: Distance education, teleconsultation, telemedicine, environmental epidemiology, medical assistance.

APPLYING DOC@HAND TO SUPPORT THE IDENTIFICATION OF COLON CANCER PATIENTS AT PRIMARY CARE LEVELS

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The colon cancer is the second most common cause of cancer-related death in the majority of the western countries, after the lung cancer in males and the breast cancer in women. It is accepted that primary care plays a crucial role in the early detection of lesions. However, this process does not always happen in a timely and adequate manner. Doc@Hand has the potential to be a very useful tool in this type of demanding situations. By bridging the gap between patient's related data and unstructured information and knowledge, the healthcare professionals can be better positioned to access and exploit this integrated information for more effective and cost-effective decision-making. An example of applying Doc@Hand to identify those patients with a suspicion of colon cancer is currently under evaluation at the Hospital Clínic de Barcelona. The pilot involves a primary care setting where the index cases are to be detected and referred. The clinical case has been selected following the priorities established by the Catalan health authorities. This presentation will show how Doc@Hand has been applied in this scenario.

ASIAN PERSPECTIVE: FROM E-HEALTH TO U-HEALTH: NTUH EXPERIENCE

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From 1994, NTU Hospital has started the first telemedicine and e-Health program in Taiwan. In recent years, NTU medical informatics research team work on a mobile hospital project to provide ubiquitous healthcare in an aging society for anybody, at anytime and in anywhere.

Keywords: Ubiquitous healthcare, telemedicine, wireless network, mobile hospital, e-health

ASP MODEL VALIDATION

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Another project goal is to validate the possibility to offer Doc@Hand not only as independent platform, but also accordingly an ASP model, where an institution acts as a service provider for an enlarged, cooperating organization.

Running Doc@Hand in ASP mode would mean having a single, specialized provider who runs multiple instances of Doc@Hand that are physically separated from each other; this could leads to several advantages such as costs reductions, no maintenance, and so on.

This presentation will explore the actual state of the art of our evaluation, explaining what could be the possible architecture that will be less powerful respect to the standard one because of outsourcing sensitive information processing (privacy and security policy issues).

AUTOMATIC FALL DETECTION AND ACTIVITY MONITORING FOR ELDERLY

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Our modern societies are suffering the increase of elderly population while at the same time social security and health costs must be cut down. In order to avoid the need of special care centres, both to reduce costs and to improve elderly people quality of life, the actual trend in Europe and North America is to encourage elderly to stay living autonomously in their own homes as long as possible. However, due to health problems mainly, elderly are more subject to problems and need of assistance in their daily life. For most of them, living alone is not acceptable, and generates insecurity, fear, restriction in their activities and anxiety or concern from their carers or families. Professional carers may of course help elderly in their daily life, but they never can give a 24 hours service a day. Another mean to support elderly is to provide them adapted and reliable telemedicine systems, to make them more confident, to support them in case of emergency, in fact to improve their quality of life. The product presented in this paper contributes to this objective, since it provides automatic fall detection and activity monitoring both for indoors and outdoors activities, associated to a complete call centre for medical monitoring of the patient as well as to provide support and manage emergency situations.

The fall detector and activity monitoring device is being developed within the European CRAFT project HEBE, with centres and SMEs from Spain, France and Greece. It is constituted by a small mobile module worn by the user during its daily activities, and a call centre to receive and manage information sent by the mobile module. Three main functions are by now implemented in the product: automatic fall detection (with alarm sent in case of a fall), daily activity monitoring (with daily report of user's activity for medical monitoring), and user localization for emergency coordination.

In order to allow an indoor and outdoor use of the system, mobile and wireless technologies have been used. Indeed, the mobile module incorporates GSM/GPRS together with stack TCP/IP to send data (activity monitoring and alarm) between the mobile module and the call centre. For user localization, the system incorporates a GPS receiver.

The module works in an autonomous way, without intervention of the user. In normal mode, a daily activity report (degree of activity during the day) is sent to the call centre for medical monitoring. In case of alarm (due to a fall or abnormal activity), an alarm message is sent to the call centre with all information required to deal with the emergency. Furthermore, the user has the possibility to cancel or to set manually an alarm, and the call centre offers the possibility to retrieve position or activity report at any time.

Keywords: fall detection, activity monitoring, elderly, tele-assistance

BROADBAND MEDICAL NETWORKS, HEALTHGRID AND CYBERINFRASTRUCTURE

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One component of cyberinfrastructure is network connectivity. An understanding of U.S. regional and national network activities provides optimal strategies to support exemplary science in support of the local, regional, national and global health community. Important trends in biomedical research include the rapid accumulation of data and a broadening scope of collaborative research activities. Telehealth effects real-world requirements for cyberinfrastructure. A global activity is emerging within the medical community to address this, coming together under the HealthGrid.

A HealthGRID is an environment where data of medical interest can be stored, processed and made easily available to the different healthcare participants: researchers, physicians, healthcare organizations, the public health sector, healthcare administration, individual citizens and other communities of practice. If such an infrastructure were to offer all necessary guarantees in terms of security, respect for ethics and observance of standard regulatory frameworks, it allows the association of post-genomic information and medical data. The possibilities open up new mechanisms to improve healthcare across a continuum of sectors.

BUILDING CLINICAL CAPACITY IN AFRICA: THE SEARCH FOR COST EFFECTIVE, SCALABLE SOLUTIONS

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This paper reports on the initial stage of a three. year program to establish a system to build clinical capacity in Africa. In this paper, we present the problem, need specification, research question, method and initial findings.

Background to problem: The Commission for Africa has called for an additional 1,000,000 doctors for Africa by 2015. The insufficiency of medical capacity in Africa is one of the key contributors to the nexus between poverty and ill health that besets the continent. The problem is that while African's suffer disproportionately from diseases of poverty (including diarrhoea, tuberculosis, and respiratory problems as well as high levels of traumatic injury and maternal and child mortality), tropical diseases (including malaria) and HIV/AIDS, African nations have the lowest ratio of doctors to population in the world. With only 1.3% of the world's medical workers and 25% of the world's disease, the need for capacity building is apparent. The goal of 1,000,000 cannot be reached given the current capacity of medical schools. Moreover, there is a steady exodus of African doctors to developed nations. The situation is comparable with nurses – Britain alone accepted 3,000 African nurses in 2003.

Need specification: Therefore, there is a need to establish a system to build non-poachable, clinical capacity focused on the seven conditions (diarrhoea, tuberculosis, respiratory problems, traumatic injury, maternal and child mortality, malaria and HIV/AIDS) that account for the greater part of mortality and morbidity in Africa. The system should be cost effective, scalable and sustainable by not-for-profit at the completion of the project. In order to avoid a 'white elephant' the system should be deemed useful and useable by the patients and workers in situ, and it must be socially and politically acceptable and largely rely on existing resources.

Research question: What system will cost-effectively build clinical capacity in Africa in such a way that it will be scalable and sustainable and will be appropriated by relevant parties, while being unpoachable?

It is assumed that the system will involve information and communication technologies as purely face-to-face or book-based systems are considered not to scale.

Method: The project takes the need specification as a platform for a multistage approach.

Stage 1 – research. The research method is largely exploratory as it was not known what level of capacity and what embodiment of that capacity would be deemed appropriate at the trial locations, or what system could build that capacity. The level and embodiment possibilities range from 'barefoot' to consulting clinician, where 'barefoot' might imply a person otherwise clinically untrained (not a nurse) with enough knowledge to undertake rudimentary diagnosis and treatment in one of the foci diseases with online support from clinically trained others. Issues to be researched:

- Investigation of existing schemes to build clinical (or cognate) capacity using ICT. This research is agnostic to location
- Investigation of local conditions (social, regulatory and resource) in the seven locations chosen for the project (one rural South Africa, one rural and one urban Mali, one rural and one urban Mozambique, one rural and one urban Rwanda) that would determine the selection of not only the level and embodiment of capacity, but also how that level would be achieved.
- Cost effectiveness evaluation of promising systems. The use of modelling techniques allows the scalability to be tested and then the least cost of achieving 15,000 'graduates' per annum to be estimated. At this stage, by assuming that the locations have fixed and GSM connectivity, we exclude those costs from the system selection process. This is not unreasonable, given recent ITU figures.
- Selection of locally acceptable, cost effective methods to build clinical capacity. Online Delphi techniques enable experts informed of the outcomes of the above research elements to resolve issues and come to an agreement on the most appropriate capacity building system(s) to trial.

Stage 2 – preparation. Including the identification of infrastructure and equipment requirements for each location, identification of existing clinical content relevant to the 7 foci diseases and suitable to the selected system, development of content if necessary, and translation of content or of system material as necessary.

Stage 3 – trial. This, the longest stage involves the installation of infrastructure and equipment, training of participants in the system, running the system for two years with as many rounds of participants as the system allows, and evaluating both the students and the system.

Findings: With Stage 1 underway, the early findings are that:

- there are very many efforts underway to build clinical capacity in Africa using ICT.
- Organisations active in this endeavour include national governments globally, UN organisations, NGOs, philanthropy arms of corporations, religious orders, universities and combines of these.
- Most support clinical decisions by Africa-based, clinically-trained personnel and/or offer opportunities for Africa-based, clinically-trained personnel to upgrade their qualifications online.
- Efforts are not coordinated and very few are evaluated in terms of capacity built, health service outcomes or costs to the provider or recipient.
- Some of the efforts have multiple goals (such as training students in the donor university).
- Some of the multiple goals may be counter productive to the goal of building clinical capacity. For example, one university has as a goal 'qualification portability' that actually enables the poaching that

Keywords: development, economics, capacity, Africa

BULGARIA AND THE FIRST ACADEMIC ASSISTED DISTANCE EDUCATION IN TELEMEDICINE

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The dynamics of 21st century requires application of contemporary educational technologies. Constantly arising in these days is the practical use of the World Wide Web, Internet and Intranet, which are the basics of the science developments and communication instruments of universal dimension.

The information presentation should be changed in qualitive and quantative way. WEB-based educational models are the main alternative in the academical system, because the requirements for place, time and information volume became useless and unnecessary. They will be defined from the individual person, in relation with his possibilities, desires and aspirations.

Approximately 1.61 million are the Internet users in Bulgaria according to data from September 2004, based on study of Computer Industry Almanac (CIA).

"Telehealth and cyberhealth" and "Telemedicine" are courses, purposefully designed for the academical education in NBU, and they are performed for the very first time in Bulgaria. Except their content richness, these courses are modern in the way of teaching – distance model with interactive information exchange, aiming to ensure the real going into the material essence. Besides the well-designed theoretical background, there are available multitude web-bibliographic resources; multimedia – audiorecords, videomaterials and PowerPoint presentations, which ensure and stimulate the visual perception of the subject. Also we have published in 2001 the First Telemedicine Glossary of Working Documents, Glossary of Concepts. Technologies, Standards and Users, translated into Bulgarian mixtured with a Telemedicine textbook, which was approved by the European commission.

Our goal is to present a working education program with one of the modern distance software platform Moodle, which not only helps the students to work at home with the materials, but to become familiar with the environment of telemedicine experts – through the distance, time and space.

In our article we are going to define the current situation in Bulgaria – healthcare background, working projects, textbooks and already prepared lectures, completely comfortable to the western educational models. In order to introduce to the students the newest technologies today we use a lot of sources – not only WWW, but books from Amazon. COM and the opinion and experience of one of the most famous experts – prof. Bernard Richards.

CARAMEL: A PLUGIN-ARCHITECTURE FOR THE SECURE INTEGRATION OF STANDARDS IN MEDICAL INFORMATION SYSTEMS

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Integrating data into an information system is a common ETL-task (extract, transform, load). Data has to be extracted from different data sources, like databases or files, transformed into other representations and loaded into a database. In order to achieve a consistent database and a high level of data quality the data can be transformed and observed using the following steps:

- **Data Cleansing** is the task of combining or decomposing data fields, eliminating duplicate data or replacing data with other data.
- **Data Profiling** is the task of creating profiles in order to analyze the data frequently. E.g. ranges of data types and the correct usage of predefined values can be checked.

Data quality is a critical aspect for the acceptance of an entire information system. Therefor data quality management is a very important part of a data integration process.

Regrettably often isolated applications exist which focus either on the semantically part of integration where cleansing and profiling is important or on the integration of data sources. Latter support the extraction of data from databases, using ODBC-driver, for instance. They don't allow integrating uncommon data sources, which do only exist in special domains.

Cancer registries have to integrate data created with applications running in surgeries or pathologies. These applications produce files which correspond to several standards. Examples for these standards in the German public healthcare are BDT,

dc-pathos or HL7. Due to security restrictions these files often have to be transferred using an encryption algorithm like PGP.

CARAMEL is an application based on a plugin architecture. Plugins for the integration of files according to BDT, dc-pathos, xBase, CSV's and OCR-created files exist. After the extraction from these files the contained data can be transformed using intermediate representations. In these representations the data quality can be increased using Data Cleansing and Data Profiling plugins, which allow verifying the data for standard-conform values. Minima, maxima, data types and formats have to be checked and illegal values have to be transformed to defaults in order to achieve consistent data. The task of filling the database with the modified data is supported by a XSLT-plugin. XSLT is used because the database schema is being altered frequently. It is very flexible and the templates can be modified without recompiling.

The talk will describe the architecture of the CARAMEL application and its usage in the context of the CARLOS project. This project supports the data analysis, record linkage, statistically investigations and reporting for supporting the cancer research in Lower Saxony of Germany.

Keywords: Healthcare, Plugin architecture, Integration, data quality management

CLASSIFICATION FOR METHODS OF TELEMEDICINE EFFICIENCY INVESTIGATIONS

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The telemedicine is promptly integrated into system of public health care. A plenty of various projects is carried out, various organizational, medical, technical, economic decisions are offered. We believe, that now has ripened necessity of creation of the unified system for efficiency investigation of telemedicine. Of course creation of such system cannot be limited to frameworks of the one or two publication and demands long joint efforts of various experts. This article is prepared by us for the review and primary generalization of methods for telemedicine efficiency investigations (MTEI). Dr. Noriaki Aoki et al. (2003) propose classification of "telemedicine results". After own telemedical activity and analysis of different origins we are propose own classification too: 1. Clinical MTEI: investigation of establishment activity efficiency; investigation of diagnostic, treatment activity and outcomes efficiency; investigation of diagnostic accuracy; investigation of moral efficiency. 2. Non-clinical MTEI: investigation of economical efficiency; investigation of psychological status; investigation of technical efficiency; investigation of management efficiency.

We hope this classification will be useful for planning of scientific researches in telemedicine. Statistical methods for investigation: comparison, analysis, kappa, receiver operating characteristics (ROC) curves, mathematical modeling. Thus, methods for telemedicine efficiency investigations are analyzed and classified. A following stage of this research – creation of system for telemedicine efficiency investigations for clinical, scientific practice and decision making. **Clinical MTEI.** *Investigation of hospital/institutional activity efficiency*. Comparison for various parameters of medical establishments' activity. And search of statistical dependences between them at use of telemedicine and standard ways for medical care. Here can concerns: level of surgical activity (on the background of telemedicine usage), parameters of death rate and mortality, duration of a pre- and in-hospital stay, etc. *Investigation of diagnostic, treatment activity and outcomes efficiency*. Searching for statistical dependences and comparison for various parameters (outcomes, level of complications, clinical mistakes, death rate and mortality etc). *Investigation of diagnostic accuracy*. The comparative analysis of quality, accuracy and specificity of diagnostics, description of the local status and recommendations for treatment with or without telemedicine. *Investigation of moral efficiency*. For studying efficiency of the telemedicine use an estimation of moral efficiency or satisfaction of patients and doctors from the lead telemedical procedures. For an estimation of satisfaction of the patient use various questionnaires and test, like: SF-36, Short Form-12 etc. **Non-Clinical MTEI.** *Investigation of economical efficiency*. There are methods for estimation of economic efficiency of the telemedicine: cost-minimization, cost-effectiveness, cost-utility, cost-benefit analysis. *Investigation of psychological status*. The important and interesting aspect – research of the psychological status of various participants of telemedical procedures

(patient, remote adviser, attending physician, coordinator, support personnel). It is quiet new field for investigations in telemedicine activity. *Investigation of technical efficiency*. Testing of the equipment, comparison of accuracy of various telemedical systems etc. *Investigation of management efficiency*. For an estimation of management efficiency of the telemedicine in comparison study: time parameter (duration of medical procedure, visit, detour, survey, etc.), quantity, duration, productivity of transportations of patients between medical institutions of a different level.

Keywords: telemedicine, efficiency, economical and clinical results, outcomes, classification

CLINIC: COLLABORATIVE PLATFORM FOR SUPPORTING KNOWLEDGE MANAGEMENT PROCESSES IN THE HEALTHCARE SECTOR

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CLINIC project aims at making available a KM (Knowledge Management) service supporting the transaction of knowledge and competence between healthcare experts all over Europe and to support the professionals in taking evidence-based decision at the point of need.

Medical research, clinical evidence and case studies (trials) enormously increased (and will continue to increase) the medical knowledge. On the other hand the progressive specialization of medical doctors and healthcare professionals gives way to the creation of specialized and often very technical knowledge domains, dedicated to elites of specialists, difficult to be shared to family doctors and healthcare professionals in general, outside these restricted circles.

So it is possible to say that the increase of medical knowledge conflicts with the diffusion and usage of it in the "usual" daily medical practice exercised by general practitioners and by family doctors operating on the territory, who are lightly linked to the research networks and to the scientific community.

This paradox (wider and wider medical knowledge practically used by less and less segments of Health Care professionals) can be overcome by the CLINIC service which aims at "making effective knowledge available and immediately usable by any Healthcare Operators (General Practitioners, other medical specialists) operating on the territory".

The main objective of the CLINIC proposal is to roll out a web and mobile based medical service, enabling the evaluation of the exploitation potential of a collaborative work environment for the Management of Health Knowledge and Competence in the context of large health care systems.

The set of specific services that CLINIC will make available in the European market are:

- Mobile/web-based Intranet Knowledge Warehousing tool that allows implementing a distributed, cross functional and multi-tier archiving and warehousing of healthcare organisation knowledge and its retrieval. The knowledge warehousing amasses *internal* (such as core competencies, know-how, strengths, weaknesses, lessons learned from past experiences, best practices) and external *knowledge* (such as awareness of the research, statistic, regulations, society trends, inter-organizational practices).
- Groupware Applications: this term indicates a set of tools to let Regional Healthcare Network operators to work and to share information together directly using the CLINIC system.
- Mobile Collaborative Environment (built on Web-based groupware tools), to support a more realistic collaboration and knowledge sharing and transferring also among geographically distributed workforces, within and between healthcare organisations.

The final objective of the project is to identify different ways for the commercial deployment of the CLINIC multilingual, interactive, web and mobile-based services, and to promote Community-wide good practices for online healthcare knowledge management services.

CLINIC application will be tested and evaluated in three different healthcare organisations: Athens Medical Center (Greece), Azienda Ospedaliera of Parma (Italy), Medsana Hospital Bucharesti (BU). The aim of the paper is focused on the description of the general CLINIC functionalities activated in the three pilots sites.

Keywords: knowledge management, collaboration tool

COMPUTER SKILLS AND DIGITAL DIVIDE FOR HIV/AIDS DOCTORS IN LOW RESOURCE SETTINGS

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Lack of access to information remains one of the major barriers to evidence-based medicine in low resource settings. Limited access to computer facilities, to literature databases and to continuing medical education (CME) programs are just some examples out of the full range causing disparities in universal access to health care information. Worldwide just 14 percent of the population is online and besides the lack of resources, several other factors as users' skills, time availability, and return of investment are contributing to the information and communications technologies (ICT) gap.

In order to decrease the barrier to evidence-based medical information the Institute of Tropical Medicine, Antwerp (ITMA) supports physicians working in low resource settings on HIV/AIDS care with a telemedicine service (*http://telemedicine.itg.be*). The physicians can send difficult clinical cases and questions to a web-based discussion forum. A network of HIV/AIDS specialists is responsible for their discussion and the formulation of a final advice. Clinical images and bibliographic material are used to accompany questions and answers. Interesting cases and recurring questions are elaborated as case rounds and frequently asked questions (FAQs), consultable through the search function for CME on the website. User-friendly guidelines, links, digested conferences coverage and news always targeting low resource settings are also available for consultation. This telemedicine service is directly linked with a Short Course on Antiretroviral Treatment (SCART). During this 3 week summer course on HIV /AIDS care and use of antiretrovirals, participants receive an initiation on how to use the telemedicine service.

At the end of the SCART in 2004 and 2005 we assessed the trained physicians' access to the World Wide Web (WWW) and their abilities/attitudes in using computers while working in the field. Out of the total of 84 trained physicians, who were mainly African and Asian nationals working for international organizations or for the ministry of health, 75 completed the questionnaires. While 11% of the physicians stated not to have access to the WWW, almost all of them mentioned to have an own e-mail account (74/75). Of the interviewees, 69% preferred to access the internet in the evening hours (5-12 PM). A connection speed of at least 28.8 kbps was available to 40% of the audience. For 83% the operating system in use was Windows 2000/XP, 93% had a CD reader, and only 63% had a sound card on their computers. Two thirds of the users reported to be able to download files and to use software such as Acrobat, Excel, PowerPoint, WinZip, and Word.

Although the WWW access, ICT ability and use remain limited in low resource settings, our selected group of physicians working in the field of HIV/AIDS showed a good level of basic informatics knowledge, ability in using computers and access to internet. This type of online tools creates opportunities for CME and support in the management of difficult HIV/AIDS cases for colleagues working in low resource settings.

Keywords: telemedicine, HIV/AIDS, developing countries

CONGESTIVE HEART FAILURE (CHF) AND VIRTUAL HYPERTENSION CLINIC (VHC)

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Optimal management of patients with congestive heart failure (CHF) has to detect a beginning haemodynamic imbalance in time through daily weight monitoring in order to avoid decompensation and hospital admission.

The "Virtual CHF Clinic" has been designed to serve as an easy to use automatic 'wireless' telemonitoring system used by CHF patients for daily transmission of physiological and clinical parameters to a remote general practitioner or a healthcare provider. By means of a simple, interactive communication between the healthcare professional and the patient, based on client-server interactivity, the CHF disease can be monitored "on-line", timely and in time.

Using the "Virtual CHF Clinic" enables, by the daily weight reporting, to reduce re-hospitalization and mortality and increases the quality of life of the patients with heart failure.

A "Virtual hypertension clinic" organizes the transfer of primordially weight and blood pressure readings, measured by the patient at home, and the permanent archiving of their trends by means of modern information and telecommunication technologies. It bridges the spatial distance between the patient and its healthcare professional, allowing therefore the daily on-line observation of the patient's condition and a better possibility to adapt it in time.

By using the "Virtual CHF clinic", optimizing continuously the therapy and strengthening the relationship between patient and healthcare professional, costly re-admissions can be avoided and the patient's quality of life improved.

Clinical trials and randomized studies show that, although the prevalence of CHF patients economically only accounts for 3 – 5%, they are considered to be the most expensive ones, because of the frequent hospital re-hospitalizations. By using telemonitoring systems, such as the "Virtual CHF clinic" the cost per patients of the CHF treatment can be reduced by 30% of the primary care costs. Clinical trials also reveal that the mortality can be brought down by 56%.

Critical success factors however emphasize the importance of easy to use processes so as to maximize the patient's adherence to the therapy, intelligent management of vital signs and symptoms, dedicated specific resources such as trained nurses who's tight relationship with the patient allows for coaching and stimulation of the patient's active participation in self-management his or her disease.

CONTRIBUTION OF EUROPEAN COMMISSION TO GLOBAL LEADERSHIP OF EU IN EHEALTH DEPLOYMENT

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Since 1988, about 650 million Euros in EU contributions have been granted by the European Commission, ICT for Health Unit to approximately 450 R&D projects in eHealth programmes alone. Many more projects were also supported by relevant programmes such as eTen programme. Many of these research results have now been tested and put actively into practice. European Commission was one of the first agencies to support on large scale research and deployment of eHealth solutions. These solutions have over the last 10 years scientifically proven real benefits in access, quality and productivity, when accompanied with the right organisational changes and improvement of skills. The deployment of eHealth solutions varies greatly among European countries. Examples of real life solutions will be presented. Current challenges in development of European-wide sustainable market and interoperability of solutions will be discussed together with the activities of EU to tackle these challenges.

Keywords: eHealth, interoperability

DESIGN OF BLUETOOTH BASED LOW COST CARDIC TELEMONITORING SYSTEM

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This paper describes design and implementation of low cost continuous cardiac telemonitoring system using bluetooth. The system is capable of acquiring and storing of patients ECG data and transfers it in real time to remote locations. The system consists of biomedical signal acquisition and conditioning circuits, digital signal processing and wireless communication subsystem. The acquisition part acquires an ECG signal through electrodes and then amplifies the weak signal by an amplifier and filter out the same signal. The ADC module circuit performs A/D conversion of an ECG signal and digital output is sent to patients local PC through an RS232 interfaces, which enables patient's data to be stored into a patient's local networked PC via blutooth interface. The networking system establishes TCP/IP links across wide area communication to the physicians, located at central hospital for monitoring, diagnosis and create patient medical record at a significantly low cost.

DEVELOPMENT PORTABLE TELEMEDICINE STATION

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Protable telemedicine applications have been enhanced by the enormous growth and disponibility of communication networks of several technologies in our region, and with the low cost of mass storation devices now available in our markets.

The prototype we are presenting here consist of a central processor wich has VGA video output and connects to a TFT monitor. The operative system and communication system was implemented using USB devices. In this way, instead of a conventional hard drive we can use a 1GB memory pendrive as support for the operative system and the developed applications.

Patient signals are captured using DPS 56F8300 (Motorola) family. The implementation allows software configuration of the devices according to the desired application (at the start, the device inquire to the main station which parameters need to be configured, and then configures itself). Communication among patient units and central station is obtained via Bluetooth.

The same unit, mounted on an aluminum case of 50 x 30 x 15 cm, allows for two configurations:

– As single diagnostic unit: with administrative capabilities, satelital positioning, and multiple connectivity (satelite, MODEM, radio VHF, mobil telephony, or WIFI). We are now working on development of clinical laboratory instrumentation in order to obtain portable diagnostic tools.
– As monitoring unit for emergency Intensive Care Unit, with capacity up to 16 patients

System configuration is fully preloaded in the pendrive, therefore, to choose a particular configuration the system needs only to be booted using the corresponding pendrive. The system can be also booted as personal computer.

We believe that in this first stage, we have obtain a proof of concept unit. We are now working towards the energy supply to the unit, alternatives include eolic or solar energy.

Keywords: telemedicine, remote monitoring, e-health

DISSEMINATION AND EVALUATION TOOLS FOR eHEALTH PRODUCTS, SERVICES AND DISTANCE EDUCATION

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Two evaluation and dissemination tools are described to provide technical support to Member States in relation to eHealth products and services by disseminating widely experiences and best practices and evaluating the knowledge of students in e-health distance education.

The first tool is the evaluation system ExaMe focused on the use in distance education. The first version of the ExaME system was applied in frame of the European project IT EDUCTRA (Zvarova, 2000). The second version of the system ExaMe was developed in the period 2001-2002, presented at the International Joint Meeting EuroMISE 2004, in Prague, Czech Republic and some features described in details in (Martinkova, 2006). The third version is under the development with the support of the project CZ.04.3.07/4.2.01.1/0013. The service ability of the ExaMe evaluation system as the supporting evaluation tool has been repeatedly shown since 2000 at the courses of Ph.D. studies in Biomedical Informatics at Charles University in Prague (Zvarova, 2002). The ExaMe system also has opened new possibilities for self-evaluation in distance education, especially when joined with electronic books on Internet.

The second tools are the new European Journal of Biomedical Informatics (EJBI) that is reacting on the great European need to share the information in the multilingual and multicultural European area. EJBI (*http://www.ejbi.org/*) opens for the field of biomedical informatics a new model of electronic publishing. EJBI is publishing peer-reviewed papers submitted in English with their other European languages versions simultaneously. This opens new possibilities for faster transfer of scientific-research pieces of knowledge of many European countries to a large international community of biomedical researchers, physicians, other health personnel and citizens. Moreover, the journal now enables to make results of scientific-research work and practical experiences of foreign specialists accessible to

wider health public in a more comprehensible way in each European country.

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Keywords: eHealth, Distance Education, Dissemination, Evaluation

DISTANCE CARDIOLOGY AND REMOTE PSYCHOLOGY CARE: IS THIS THE SUCCESSFUL FORMULA

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The aim of this presentation is to offer a brief overview project 7 – BUL/03/001 co-funded by Bulgaria and International Telecommunication Union (ITU), Switzerland. The project was developed in conjunction with the Valetta Action Plan, which sought to promote universal access to basic telecommunications and Internet as tools of development in rural areas. Project target area is Septemvri community, Bulgaria.

The paper will emphasize on development of telecardiology (monitoring and transmission of ECG, blood pressure and heart rate data) as part of multimedia applications. In addition to telecardiology, attention will be dedicated to telepsychology counseling. The latter is offered to local medical staff, cardiovascular patients and people from target region in the period 2006-2007 as part of another ongoing project (OHN 1514/2005 funded by National Science Fund, Bulgaria).

Keywords: telecardiology, rural areas, depression

DOC@HAND – THE ANSWER TO PATIENT RECRUITMENT

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The presentation will begin with the rationale for utilising Doc@Hand in the clinical trials setting, examining UK government guidelines and national incentives and acknowledging the present obstacles preventing successful patient recruitment.

After a brief insight into the current selection and recruitment process Doc@Hand will be demonstrated in its clinical trial incarnation. A comparison of the Research Nurse versus Doc@Hand will illustrate the potential uses and clinical need for the system as well as highlighting its simplicity for clinicians using it.

The presentation will conclude with a demonstration of the benefits of Doc@Hand and its potential impact on clinical trials in the NHS.

DOKTER.NL DIGITAL CONSULTATION

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Dokter.nl Digital Consultation (*www.dokter.nl*) offers medical consultations over the Internet.

The DDC is an innovative contribution to health accessibility by increasing consultation efficiency with Internet solutions. The entire health care process, from client and doctor to consultation and secure medical file is incorporated in one Internet application.

The DDC is nominated by the national department of Health of the Netherlands as best practise for the "European eHealth Award"

E-health, RIVM rapport, May 2002

Health and internet, rapport RVZ July 2003

KNMG, Guidelines internet consultation, 2006

Keywords: Tailored health advice, Digital medical file, Medical specialists, Internet

EHEALTH AND DIGITAL MEDICINE IN THE VIRTUAL HOSPITAL OF THE FUTURE

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For the realization of global health care dedicated 24/7 telemedicine and e-Health services are needed. These services should meet reliable and high quality of service (QoS) constraints. Open source and open standard solutions are needed for interoperability and integration of the various services offered by different institutions and gateways to other communication networks should be created. Implementation of remote control of medical devices will enhance telediagnosis and help to realize an equal access to medical expertise irrespective of the geographical location of the person in need. The medical workflow and decision-making tree has to be re-evaluated and new management tools and strategies for global virtual alliances have to be introduced. Mental, intellectual and educational e-services for the citizens shall be created.

Pre-operative planning, navigation and robotics offer advantages e.g. in minimally-invasive surgery by increasing the precision and shortening the recovery time of the patient. As minimally-invasive medicine is image guided it requires an adequate fully digitized environment for optimized usage in clinical routine. Navigated instruments support surgical operations in neurosurgery, craniofacial or liver surgery, etc. Information and Communication technologies contribute to digital radiology, digital pathology, telemedicine and navigation and simulation. All these areas produce an information flood. To deal with such an amount of information, personalized avatars to represent the user virtually in an online community of medical information systems and multi perception for multi media performance in virtual reality environments (visualisation of virtual 3-D objects, full navigation, haptic simulation, etc.) are needed.

In recent years, different institutions have launched several Euro-Mediterranean telemedicine projects. All these projects have demonstrated how the digital divide is only a part of a more complex problem, the need for integration. Therefore, provision of the same advanced technologies to the European, to the Mediterranean and to the Adhering Countries should be the final goal for contributing to their better dialogue for integration.

The Virtual Hospital aims to facilitate and accelerate the interconnection and interoperability of the various services being developed (by different organisations at different sites) through real integration. Due to the distributed character of the Virtual Hospital, data, computing resources as well as the need for these are distributed over many sites in the Virtual Hospital. Therefore Grid technology becomes inevitable for successful deployment of services like acquisition and processing of medical images, data storage, archiving and retrieval, data mining (especially for evidence-based medicine).

Keywords: Real-time telemedicine, satellite-based network, health Grid

E-HEALTH AS A TOOL TO IMPROVE ACCESS TO HEALTH-CARE SERVICES IN DEVELOPING COUNTRIES

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This presentation has been prepared on the basis of several reports made as results of study on Telemedicine for the needs of developing countries in the Study Group 2 of the Telecommunication Development Sector of the International Telecommunication Union and the Resolution 41 on “eHealth” by the World Telecommunication Development Conference which took place in March 2002 in Istanbul, Turkey.

It is believed that success of the introduction of eHealth solutions and services depends very much on how the telecommunication authorities from developing countries can establish the mutual beneficial cooperation with healthcare authorities in their respected countries and offer to them the full potential of modern information and communication technologies (ICT) to improve access to and even quality of healthcare.

It is important to develop strategies to guide the international utilization of ICT in the global healthcare environment for the benefit of all.

Conference has recommended that the BDT has to study the potential of telemedicine to meet some of the needs of developing countries in the improvement of access to the healthcare services. The past several years have witnessed an explosive growth of the “informatization” of support to health care, especially in the industrially developed countries. In many cases these projects deal with Hospital Information Systems (HIS) and teleradiology with particular emphasis on PACS (Picture Archiving Communication Systems).

The working method of any Study Group in the ITU is to study a Question by a team of volunteers from different countries – Member States. Therefore the ITU Study Group is able to present a worldwide experience and to share the information on best practice among countries. The ITU telemedicine group is unique in the world dealing with the needs of developing countries and it consists with experts from developed and developing countries.

Keywords: Telemedicine, Developing countries

eHEALTH PROGRAM IN GEORGIA

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The emergence and growth of information and communication technologies are touching many spheres of life. eHealth means the usage of information and communication technologies for healthcare reasons. This is rapidly developing field which presents a unique opportunity for the development of public health. eHealth has many socio-economic benefits, which will apply not only to healthcare delivery, but also to public health governance, finance, education, research, health-related economic activities and especially to information and communication technologies' providers. eHealth should have an impact on healthcare system by making health service more efficient and improving access to care, especially in remote areas, for people with disabilities and for the elderly. It should benefit healthcare providers, professionals, and final users through higher quality of care and health promotion. It should also affect the cost of care by reducing redundancy and duplication of examinations and making possible economies of scale. But eHealth should be managed well and implemented carefully.

The Georgian Telemedicine Union (Association) worked out the "eHealth Program in Georgia", implementation of which will ensure and realize the following:

1. eHealth network in Georgia:
   - general accessibility to healthcare;
   - organization and control of medical services;
   - increasing the quality and efficacy of medical care;
   - reduction of healthcare costs through reducing redundancy and duplication of examinations and also by reduction of patient traffic and hospitalization days;
   - distribution of modern knowledge.
2. Strengthen and maintain collaboration with global partners. There are several reasons why this is important. One is that the spread of epidemics around the world constitutes a major global health crisis. It is beyond the capacity of any single nation to deal with the epidemics effectively. All nations share the responsibility for addressing it, for humanitarian as well as practical concerns. Another reason is the objective that creation of worldwide eHealth network will ensure successful fight against bioterrorism.
3. eLearning – will ensure distribution of modern knowledge in the most effective and economic mode among healthcare professionals.
4. Improve and sustain knowledge, skills and practices tailored to local epidemiological circumstances – eHealth is an effective strategy for making progress toward the control and eliminate of diseases: the improvement of knowledge, skills and practices regarding epidemics.

Keywords: eHealth, eLearning, Information and Communication Technologies.

ELECTRONIC HEALTH RECORD IN CONTINUOUS SHARED DENTAL CARE

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The European Centre for Medical Informatics, Statistics and Epidemiology (EuroMISE Centre) is the joint workplace of Charles University, Academy of Sciences CR, two hospitals and University of Economics. The EuroMISE Centre focuses on new approaches to the electronic health record (EHR) design. The participation in European projects as well as the CEN TC 251 standards and the cooperation with physicians have produced much experi-

ence, which helped to develop a pilot EHR system called MUDR (*MUltimedia Distributed Record*) (Hanzlicek, 2004), (Hanzlicek, 2005). It is based on the three-tier architecture with an unusual data-storing approach based on so-called knowledge base and data-file principles. Within MUDR development an extra branch was separated simplifying both the MUDR architecture and the MUDR data-storing principles. It creates the *MUDRLite* EHR (Spidlen, 2004) application, which can be without problems deployed to a particular environment.

One of pilot applications developed within this applied research is the MUDRLite universal EHR system. To gain MUDRLite's user-acceptance in the field of dental medicine we have developed a high-advanced component representing the dental cross, which is a crucial part of medical documentation in dental medicine. So-called DentCross component will be described in more details. The data model of this component originates in the so-called Dental Medicine Data Structuring Technology Using a Dental Cross. This technology was applied by the authors of this paper for a Czech national patent under the No. PV 2005-229. First applications of the DentCross component were developed in the papers (Teuberova, 2005) and (Spidlen, 2005) with the support of the grant no.1ET200300413 of the Academy of Sciences CR.

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Keywords: Electronic Health Record, Dental Medicine, Data Model, Medical Informatics

ELECTRONIC MONITORING OF DOSING HISTORIES ALLOWS REAL TIME DETECTION OF POOR ADHERERS AND OFFERS THE BASES FOR A SUCCESSFUL INTERVENTION

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We have just finished the assembly and begun the analysis of data on more than 16000 ambulatory patients whose dosing histories during studies of varying lengths have been electronically compiled (MEMS®, AARDEX Ltd.). These data come from clinical studies whose sponsors have concurred with entering their anonymized data into a common archive. Electronic Medication Event Monitors were used to record the times and dates of drug dosing during the course of >90 drug trials between 1990 and 2005. Chapter headings in the British National Formulary served to categorize fields of treatment. Study durations ranged from 30 to 1400 days. Patterns of deviation from prescribed dosing regimens varied widely, but were almost entirely markedly skewed toward longer dosing intervals than prescribed, i.e. under-dosing, in every field of treatment. In studies continuing beyond 12 months, almost 40% of trial participants had stopped taking the trial medication, despite a prescription that called for continued taking of the drug. Drug holidays (3 or more consecutive days without drug intake) occurred at least once a year in 50% of patients. Holidays occurred monthly in 2% of the patients, and quarterly in an additional 10% of patients. Underdosing, drug holidays, and early cessation of dosing are common features in ambulatory patients, and likely are frequent sources of low response and high variability in response to the prescribed dosing regimen. In practice, it thus

becomes essential to identify, during the course of the treatment, the patients who make major errors in drug intake. The data base shows how electronic monitoring can be used to detect poor adherers and how a successful interventional strategy, based on reliable dosing histories, can be implemented to improve compliance and persistence with prescribed regimens.

Keywords: Adherence, Compliance, Electronic Monitoring, Intervention

ENVIRONMENTAL SENSOR DEVELOPMENT AND DATA INTEGRATION

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Environmental factors and public health are inseparably linked. The effects of the air we breathe and water we drink has a profound impact on the health of individuals and societies in general. Recent studies have shown that up to 80% of human illness presented at clinics in developing countries are due to water-borne factors that are largely preventable. Further, 60% of infant mortality worldwide may also have similar water-related causes. Moreover, emerging (bird flu) and re-emergent infectious disease puts additional strain on already weakened public health systems in developing countries as well. These countries also have limited resources for environmental protection/remediation and public health - these resources must be managed very efficiently toward making the greatest impact with lowest possible cost.

This presentation will focus on technological innovations which are relevant to these issues. Achieving situational awareness of environmental and public health factors requires integration and understanding of many disparate data sources over differing disciplines, time courses, and confidence levels. We will present a system that integrates public health data and other data sources automatically, and provides a real-time GIS-based Web-enabled display of linked environmental data and public health information in order to derive links between these factors and provide for an early warning system for infectious disease outbreaks (including bird flu), environmental damage, and generalized monitoring.

ESTABLISHMENT AND DEVELOPMENT OF AN INTEGRAL INFORMATION SYSTEM: FOUR CROATIAN INNOVATIONS

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Authentic Croatian design has materialized in four project approaches:

1. Central position for a Primary Health Care Information System in the health information system

Primary Health Care Information System (PHCIS) – is a key point regulating its effects. Croatian PHCIS has been devised as an integrator of all modules within the health system. One of the basic innovations in the approach to integrating data and information in health, it had been inspired by the concepts of late Professor Stampar who, as the founder of modern primary health care, also regarded primary health care as a link or integrator of the entire care delivered for the health of a people. A network of modules with a data and information integrator was conceived as the ultimate objective of the development of an Integral Health Information System. There are a number of modules to link up. The PHCIS should be the only module linked with all the other modules (hospital, laboratory, pharmaceutical, consulting specialist, other diagnostic and therapeutic points). In view of the anticipated number of events and transactions in such system, such integrator was assessed to be the most appropriate solution for developing the entire health information system.

2. Evaluation by trial run:

Clearly, a bid for the purchase of Primary Health Care Information System and of an Integral Hospital Information System has been conditioned by the need to meet special requirements that are set before the system. Another important element of the assessment imposed by the bid was to carry out a trial run on real patients, real doctors and real surgeries, which was done in 2003. This is the second innovation and the second element of the "Croatian approach". Involved in the evaluation were the foremost experts in individual areas. The

determination was made by an international evaluation jury whose members included World Bank experts, norm and security experts, and public health experts, Croatian Health Insurance Institute, and Ministry of Health and Social Welfare. They all juried each from his standpoint whether the approaches met the requirements. Both trial run and trial run evaluations showed outstanding results. It was a public revelation of bidder abilities, their strengths and their weaknesses. The Faculty of Electronics and Computing, who rated the whole project excellent, evaluated the whole project and the choices made.

3. Choosing a builder, not deliverer:

The bidding did not look for a deliverer of some prefabricated solution, but for an able bidder who would show his ability as a system builder in real time, and on genuine patients, i.e., one who would be building the system and regulating intellectual property rights, hardware and software rights, right of the source codes etc., jointly with its users.

4. Develop a PHCIS that provides at a single point for everyone concerned:

BI (Business Intelligence)

PHI (Public Health Intelligence)

HCI (Health Care Intelligence)

MI (Management Intelligence)

KI (Knowledge Intelligence),

EI (Equity Intelligence), and

II (Integration Intelligence)

ETHICAL & SECURITY ISSUES

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New technologies have vastly improved the ability to electronically record, store, transfer and share medical data but, at the same time create serious question about who has access to this information and how it is protected.

The problem of protecting electronic health data needs a concrete security policy that defines the way data are handled, transmitted and in general protected form illegal/unethical uses.

This presentation will explain how Doc@Hand deals with such problems.

EXPLORING NATURAL PROGRESSION OF HEALTH-RELATED USES OF MOBILE PHONES: AN EGYPTIAN CASE STUDY

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The expansion of mobile phone networks and services to developing countries presents a strategic opportunity for the health sector to maximize the contribution of the technology to meeting health objectives. Mobile phones were first introduced to Egypt in 1997, in the past few years the number of subscribers has climbed to over 8 million, representing 10% of the country's population. Along with increased access to fixed line services and emergency wireless systems, mobile phones are changing how health services are accessed by Egyptians as well as how they are coordinated. This paper explores the natural progression of mobile phone use for health in rural and urban communities in Minia Governorate with the objective of informing projects and policies aimed at the formal integration of mobile phones within the health sector.

Emergency healthcare has been the most significantly impacted by the increased availability of mobile phones in the general population and among health professionals whereby access to emergency services are resulting in fewer fatalities and more efficient management of emergency transportation and health personnel. Within general health services, patients reported being more readily able to mobilize transportation and access information. Health professionals described their enhanced capacity to monitor patients remotely, mobilize support for facility-based patients in their absence, and consult other physicians for more specialized information in complicated cases (telemedicine). Indirect health benefits were recounted by the entire sample, including enhanced family communication, increased gender equity, and increased household income. Barriers and impediments to fully exploiting newfound "connectedness" included cost, risk perceptions, and poor quality of information and referrals.

Qualitative research methods were used in the form of in-depth interviews (N=66) and focus group discussions among health care professionals, including physicians, nurses, administrators, and ambulance workers as well as lay users, including

students, business people, and drivers. Data was collected in 2002-2003 and were complemented by a concurrent analysis of newspapers, television, and documented observations. Additional interviews were conducted with policy makers as well as mobile phone company leaders and employees.

Keywords: mobile phones, developing countries, emergency healthcare, social determinants of health

EXTRACTING, STORING AND VIEWING THE DATA FROM DICOM FILES

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The paper presents an application designed for the Romanian hospitals and for the doctors who used devices realized under the DICOM standard and have as output a DICOM file in the process of patient consultation and diagnosing. These files can't be directly seen on a computer, so the application offers, first of all, a **DICOM viewer** which has the following facilities: a tree view of all the DICOM files sorted by their modality, an image view panel, a tools panel which contains several image processing functions (invert, blur, brighten and sharper functions, pseudo colors, edge detection), slider used to see a particular frame from multi frame images, Cine Mode for viewing a multi frame file as a motion picture, a DICOM Tag Browser organized in categories.

The second function of the applications is the one that implements several specific algorithms for extracting the alphanumeric data (patient name, diagnosis, consultation date, doctor name, etc.) and the image(s) existing in the DICOM files in order to store in a database. A structure of the database different from the one existing in the DICOM standard is proposed.

The database creates the frame for executing the third function of the application, the simple text-based query of the medical database. The proposed structure of the database has the advantage of permitting a flexible text-based query of the database using the table that memorizes the entries from the data dictionary, specified by the DICOM standard. This table is also used to extract the information from the DICOM files. A flexible query is a query that uses as parameter any of the data types from the DICOM file. The conditions given in the query can be connected by the logical operators "AND", "OR". There is a list type control in the query window, which has as articles the names of the information types from the data dictionary. There is also a text type control that will be filled with the string that will be searched in the database among the values corresponding to the selected type of information. It can be observed the existence of the Select command, which is built, in a dynamic mode, in terms of the conditions selected by the user. In fact, there aren't any limitations of the conditions or of their number, which give a big flexibility to the query.

The application correlates a MS SQL database with a DICOM viewer and a search engine. Creating a database by extracting the information and the images from the DICOM files, with the possibility to visualize and to interrogate all the data, brings high benefits to the electronic recording process of the patients. In this way, it is possible to find all the records relevant to a patient, which means all the investigations that have been made along the years using a medical device that has DICOM standard. Also, a database allows making statistical situations used on national or international level. The database contains images, so can be used in the future in the process of content-based visual query on color or texture features, that can brings advantages in the diagnosis process as well as in the medical research or medical education fields.

The Romanian doctors, taking into consideration aspects like execution speed, retrieval quality or new necessary options, test the application now.

Keywords: DICOM standard, multimedia, database, text-based query

FROM THE FRONT LINES: INNOVATING MOBILE HEALTH CARE SOLUTIONS BRIDGING THE TECHNOLOGY AND CLINICAL GAP

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One of the goals of the of the Battlefield Medical Information System-Telemedicine (BMIST) architecture and technologies was to develop a self scaling

mobile health care architecture to empower medics and providers with access to critical medical information to improve healthcare. The BMIST architectural standard provides the capability to capture, generate and self scaling information making information available to the right people. The BMIST supports point-of-care wireless monitoring to assist medical personnel with decision support and treatment. Medical personnel can also use it to record vital sign information directly into the clinical encounters and transmit those records to a central repository. The BMIST Architectural Standard makes it simple to develop user-friendly point-of-care technologies and manage medical information. With more than 20,000 BMIST in use world-wide we are collecting thousands of encounters providing a gradual aggregation of resources to aid in the development of future mobile healthcare solutions, transforming business processes and driving organization-wide benefits.

Keywords: TATRC, BMIST, Architecture, Wireless, Scaleable

GLOBAL HEALTHCARE CHALLENGES AND OPPORTUNITIES: THE ROLE OF ADVANCED TECHNOLOGY

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Advances in healthcare delivery have led to dramatic improvements in the quality of life for many; however, a gap in care remains and widens with increasing populations still facing significant threats as ancient as malaria and as modern as bioterrorism. Novel solutions for many of these problems may be found by mining emerging technologies from a variety of non-medical disciplines such as information and materials science. For example, remote diagnostics and therapeutics (telemedicine) by means of low cost, linked biosensors reporting on both individual and population health can serve to improve care in the industrialized world and significantly extend it in the developing world. Several examples of such applications exist and while challenges in funding research and integrating into clinical practice are undeniable, the opportunities call for our focus as a world community.

Keywords: TATRC, International research collaboration, advanced medical technologies, discipline fusion

HEAL FRAMEWORK: A VARIATION OF SSM

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In Health, as indeed in all business sectors, dynamic developments in technology continue to drive challenging opportunities for paradigm shifts in service delivery. Change Managers need to seek the best approaches, methodologies and frameworks for success and it is in this context that Soft Systems Methodology (SSM) has considerable potential.

This paper proposes a generic framework (HEAL) to understand and address Health Care Information System (HCIS) implementation issues.

Contents: HCIS issues, and 4 staged 11 stepped HEAL (Help understand the problem; Enquire thoroughly; Apply judiciously; Learn continuously) framework.

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Note: This is the last paper among a series of two papers; and this framework was put forward for the focus group discussion "Soft Systems Methodology for achieving successful technological adoption outcomes - History & Future" at the School of Public Health, Curtin University of Technology, Perth (WA).

Keywords: Soft Systems Methodology, SSM.

HEALTH GATEWAY – A COMPLETE SOLUTION FOR WIRELESS DATA TRANSFER AND FOLLOW UP OF PATIENT DATA

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Timely review of patient data with close to real-time feedback is a critical success factor in today's disease management. With Health Gateway maintenance and treatment become faster, easier and more accurate.

eHIT Health Gateway represent an effective and secure tool that transfers patient data from different measurements devices to the health care provider via mobile platform wirelessly. It provides patient and nursing solutions ensuring that measurement results are available, accurate and both cost and time effective.

The same mobile device can collect, store and transfer information from different measuring devices. This also makes possible the integration of devices from different manufacturers. For instance a blood pressure measuring device, a scale and a glucometer can be used to collect and register key information in diabetes care. The mobile device guides the patient and seamlessly collects information from the measuring devices. The patient can also follow up his/her progress in the therapy directly from the display of the mobile device.

The information is then automatically transferred to the heath care provider by using a secure GPRS/GSM connection. The received information can be store in the Health Gateway server or directly forwarded to existing information system. Authorised personnel of the health care provider can browse the received data and send an almost immediate feedback to the patient by using eHIT client application.

This bidirectional connection presents several advantages in comparison with traditional methods: measurement results are accurate, available in real-time and in correct form; faster patient treatment process – patient can receive feedback almost immediately; motivating treatment progress information directly available to the patient; evidence – based process traceability information: remote measurement and monitoring regardless of patient location; easy to use for both patient and nursing staff.

Health Gateway is a fully modular system, which can be delivered in different configurations ranging from direct interface between the mobile platform and an existing information system, up to a complete system including centralised server and remote/local clients for data reviewing and editing. Health Gateway already interfaces to a broad range of measuring devices allowing for remote analysis of blood glucose, blood pressure, body temperature, coagulation, body weight, heart rate, EMG, ECG, oxygen saturation, peak expiratory flow...

Health Gateway supports various mobile platforms such as Symbian OS, JAVA ME and Windows CE allowing the integration of most mobile phones, smart phones and PDA devices.

Keywords: telehealth, telemedicine, eHealth, wireless

HEALTHCARE AND NUTRITION: BIG MOTHER IS WATHCHING YOU

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Tell me what kind of food you eat, and I will tell you what kind of man you are ! Since 1825 the Brillat-Savarin's, the famous gastronomy French author, reflections on the matter people have nourished represent the most trenchant discussion of nutrition and its effects on trenchermen. Moreover nowadays it has been demonstrated that nutrition has a strong and deep relationship with healthcare, with the man's joy and in general with the quality of life. This relationship between food and healthcare is becoming day by day more important especially because with the modern technologies (Pharmaceutical/ Information Communication Technologies-ICT/ Diagnostic/Biotechnologies) is possible to monitor/ manage not only what we eat but also the effects.

This trend is striking symptom of change which we determine in the present and which give us information for our lives in the future. For example over the past few years, we've seen that organic products have moved into the social mainstream. Nowadays organic foods are going even further: organic products are increasingly becoming a central element of a lifestyle which sets ambitious targets. Today's new consumers, especially in EU-European Union are characterised by "I'll have that & that & that...." thinking:

- the greatest possible enjoyment and in harmony with nature
- the greatest possible awareness of myself, my personal development and in the interests of my environment and social circle
- the highest possible product quality and meeting clear ethical standards
- the highest quality in a healthy way.

In order to keep pace with this very interesting change in social values, it is not enough to simply wait for the next trend or wave of well-being. The food industry and healthcare sector currently has the opportunity to be a frontrunner in a new social development. This is why food and healthcare are becoming nowadays very strategic sector for industries especially for Biotechnologies, Pharmaceutical and ICT ones. In fact the ICT industries in these sectors are very close to the telemedicine and preventive telemedicine companies. From this point of view, with a preventive and holistic treatment approach, Vox Net put the attention on the food characteristics knowledge matched with the telemedicine field and the economical/financial problems in managing "foods culture" and "foods professional services" for schools, big catering companies and hospitals. In Vox Net we believe this is probably the real frontier of healthcare also because the populations of most western countries and EU are now rapidly aging. In spite of the increase in health-consciousness, a growing number of adults are suffering from so-called diseases of affluence. As a result there is widespread interest in the potential for using diet to lower the risk of common diseases like coronary heart disease, diabetes, cancer and osteoporosis. Younger people with busy lifestyles are also keen to invest in their personal health. They want quick, convenient meals that help to maintain their well-being or even prevent illness and, at the same time, taste good. Therefore there is a clear demand for healthy alternatives that are tasty and easy to make.

For sure in Vox Net we used a collaborative approach that probably is a relatively young discipline which brings together aspects of economics, psychology, sociology, food science and ICT research. Furthermore the interdisciplinary work approach is demanding and it helps us to incorporate new points of view when we plan our experiments and analyse the results.

Conclusions: In future we will assume more responsibility for ourselves and for the environment. Healthcare, healthy food, a good balance between work and leisure, and a life in harmony with nature are the key concepts in the future. Telemedicine and "good foods" has a lot to offer in response to these consumer trends. Moreover, about dietary and "gastronomy" ICT applications there is a consensus that is very helpful to provided healthcare services at home. For this reason the Vox Net developed web platforms that fit these needs.

Finally, if future is the result of a negotiation where we should, at least, have a seat and a vote let's all sit down at the beautiful, old, story-telling table winning next challenges. It's time to start!

Keywords: Nutrition, New Trends, Healthy Life, Web Platforms.

HEALTHCARE SYSTEMS TRANSFORMATION – THE ROLE OF EHEALTH

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Healthcare Systems around the world are increasingly under pressure as a result of the growing burden of chronic disease, the scale of which has been unmasked by the changing demographics in both developed and developing countries alike.

The role of eHealth is now being seen more as an enabler for healthsystem transformation as healthcare providers and governments recognise that they have to meet the healthcare demands of the future citizens. The role of IT and the development of integrated Clinical Information Systems are both fundamental to this transformational process.

At the same time technology is advancing apace and the concept of The Biological Continuum

allowing an understanding through body systems to viscera to cells and molecules down to genes will be discussed and considered.

Examples of healthcare system transformational change both on small and also on national scale will be described and some predictions made as to the likely direction as healthcare provision evolves over the next 30 years.

Keywords: eHealth, Health Systems Transformation, Radical Change, Barriers, The future healthcare environment

HOME-BASED INTEGRATED CARE IN PATIENTS WITH CHRONIC RESPIRATORY FAILURE WITH THE USE OF E-HEALTH SERVICES

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The aim of the study was the evaluation of clinical usefulness of an advanced e-health system in home-based rehabilitation, follow-up and home hospitalization of patients with advanced stages of COPD.

Methods: Eighteen subjects (mean FEV1 0.73 L) with at least four admissions for COPD in the previous 2 years were treated at home for 1 year, after an initial out-patient rehabilitation phase. The system consisted of a specially designed electronic health record (HER) and a compilation of advanced telemedicine devises (spirometer, oximetry, ECG) for the transmission of patients examinations from their homes to the hospital. Through the system the patients were able to undergo home tele-visits, with a real time video connection by the members of the rehabilitation team in the hospital on a regular or on emergency basis.

Results: During the first year, hospital days fell from 17.5 to 4 per patient as compared to the previous year. This was due to both, reduction of the number of admissions (from 2.1 to 0.4), as well as in the length of stay. Patients had a significant improvement in their quality of life (using CRQ), exercise tolerance (6 min walk test) and emotional status score.

Conclusion: It seems that the adoption of such systems in today's clinical practice can offer hospital-quality services at home resulting in improvement in patients quality of life and significant cost savings.

Note: This report is part of the **Med-ContiNET** project, funded by EU

Keywords: Home-telehealth, home telecare, COPD disease management

IMAGE SHARK – PACS-CBIR INTEGRATED SYSTEM WITH INTERACTIVE IMAGE TRANSMISSION USING JPEG2000

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Picture archiving and communication systems (PACS) are designed to provide the radiologist with image information he needs. Currently, state-of-art standard of digital imaging and communication in medicine (DICOM) gives only alphanumerical descriptions of image and this is the only information used in PACS to select relevant images [1]. However it is industry standard now, textual descriptions are insufficient to describe variety of details in medical image. The content-based image retrieval (CBIR) systems could support DICOM-based retrieval systems and fulfill "right time, right place" paradigms.

In our work we developed Image Shark – a content-based image retrieval system based on Flexible Image Retrieval Engine (FIRE), integrated with PACS solution in one, fully-integrated environment, with novel JPEG2000 codec for effective image transmission and interactive communication. Our system joins classic PACS with content-based image retrieval engine. Such approach gives very flexible and effective image retrieval ways. A set of image- and wavelet-domain based indexes were implemented, verified and selected as suitable for mammograms, CT, radiograms and other modalities. Reference medical image databases were used in the experiments (DDSM, IRMA, other datasets from Warsaw hospitals). Precision of data retrieval was comparable with other engines (IRMA, others), giving very promising results with similar or better precision level.

One of the most important parts of Image Shark is our new JPEG2000 codec. JPEG2000 image compression standard has all features to be used widely for image archiving, communication, and indexing in content-based image retrieval systems. For JPEG2000 transmission purpose the Simple Image Transmission Protocol (SITP) has been designed.

SITP defines two kinds of connections: control and image stream communication (our conception related to JPIP [2]). The control connection provides flexible way to interact with downloading images and specifies, on the fly, priorities of downloading process. The XML-based commands structure allows some extra features to be implemented for internal application use, i.e. remarks and diagnosis exchange, teleconsulting sessions and pictures sharing with other system clients.

A good result of PACS and CBIR combination were presented. It could be very effective mixture, especially with progressive and interactive transmission protocols. High efficiency of progressive and interactive transmission was realized. Significantly increased quality of images in comparison to JPEG2000 (part I) and JPEG coders was noticed. PSNR and subjective rating was used as the image quality measures. Moreover, accelerated compression process was achieved and different progression modes were verified (interactively ROI-oriented, layers, resolution and precincts-oriented).

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Keywords: CBIR, PACS, HIS, image database

IMPLEMENTATION OF A COMPUTERIZED INFORMATION SYSTEM IN ONCOLOGY UNIT

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Healthcare information systems have to guarantee quality and efficiency of the medical maintenance. For this purpose the modern trend forces to computerized information systems. Furthermore, the unambiguous need for data analysis enlarges the need for electronic data management. In particular, the labour-shared, cooperative care for cancer patients requires a complete, detailed documentation and immediate access to information. Consistently, a process-related and patient-centred information system dominated by medical and caring aspects is realized by an Electronic Patient Record (EPR) (Blobel, 2000). EPR is the core of a complex system and has additional components to work with.

Following the demands of the new era, the Oncology Unit of Athens Medical School (Sotiria Hospital, Athens, Greece) has implemented a computerized information system that consists of three modules: the EPR module, the image archive module and the lab module.

The EPR module has not replaced the existing paper-based medical record yet, but works in parallel with it. To assure the completeness and accuracy of the EPR, all data are entered from the paper-based record that works as a source. EPR module is a database application that uses a user-friendly interface. The EPR data components include clinical results (labs, procedures, etc), physician/patient care orders (orders, requisitions, consults, etc) and some administrative data (admitting diagnosis, patient location, follow-up appointments etc). All EPR data are linked to a unique Patient Record Number (PRN). The EPR module is used to produce reports, organize data and provide immediate feedback to important questions. Data entry is performed by the Unit secretary and is controlled by the supervising doctor.

The image archive module is used basically for two purposes: the reduction of images volume (CTs, X-rays, etc) and the immediate access to them. All these are accomplished through the digitization of the available image material per patient. For this task a film digitizer (Kodak LS40) is used.

Finally, the lab module stores information about the patient blood samples that are stored in the laboratory. Additionally, it stores data about the patient chemotherapies (cycle, disease etc) that need to be kept along with each blood sample. This module is very useful not only for the biologists' routine but also for the physicians who perform specialized research.

Key physicians, biologists and secretary personnel are involved in data entry and information management; the system administrator is responsible for the normal operation of the system. Data security and patient confidentiality policies are followed to assure the maximum level of system reliability.

In conclusion, the target of this system is to enrol computers in daily practice and change the paper-based status quo in order to provide qualitative healthcare to cancer patients.

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Keywords: Electronic Patient Record, Oncology, Image Digitization.

INFORMATION CENTER FOR PERSONS WITH DISABILITIES

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Accessibility to information and communication systems for PwD (persons with disabilities) is a priority for EU and candidate countries. The paper presents some results of the Romanian project "InHand – Development of information services for persons with disabilities". The main goal of the project is to contribute to improve the quality of life and health status of this group of people.

It is well known that nothing else but data exchange and shared experience may determine successful concerted actions. That is why the idea of a web site making the domain information largely available to those directly interested and to those who are in charge of the domain was born, and here is the InHand project. We call it "InHand" in the hope that we will be able to handle this problem, even with low financial support. Our expectations are that in time we will have the necessary support to develop Web-based applications on behalf of almost all categories of disabled people.

The aims of the InHand project are:

- to offer to the persons with disabilities access to a wide range of information and societal resources and a means by which they enter into social contact;
- to develop new Web-based applications for people with disabilities and older people, to enable them to participate more fully in social and economic life, eventually leading to an improvement of the quality of their life;
- to eliminate barriers to employment for workers who are disabled;
- to disseminate the "Design for all" standards for accessibility of information technology products, in particular to improve the employability and social inclusion of PwD.

The InHand database has been designed to back up the information delivery to PwD who ask for assistance. The database stores data about PwD who ask for assistance as well as data about organisations having the wish and the possibility to provide assistance for the disabled or the elderly. So, given the access to the database via the Internet, the two categories (data users and data suppliers) get easily in touch with one another.

A new project – PRO-INCLUSIVE – is going on and one of its aim is the development of a web platform for dissemination and launching the communication and debate forum for all factors involved in the promotion of inclusive information technologies. A questionnaire with around 100 questions (general and specific questions) has been developed in order to collect information.

The InHand application is in accordance with the Web Accessibility Initiative (WAI) – Page Authoring Guidelines of W3C (World Wide Web Consortium). The InHand project results, i.e. the InHand site and database, meet the requirement of a largely uncovered area in Romania: keeping informed persons with disabilities. The InHand database is an attempt to bring together potential assistance beneficiaries and potential assistance providers.

Keywords: information center, persons with disabilities, accessibility, design for all

INTERNATIONAL LAW AND TELEMEDICINE

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Telemedicine is by definition an interdisciplinary field mixing medical science, telecommunications, ethics, law, deontology, trade... As cyberspace doesn't know any border, telemedicine is at the crossroads of many legal texts addressing various issues: electronic medical record, standards, e-commerce, liberalization of trade in services, access to health services and quality of information on the Internet...

Many organizations generate rules, nevertheless there is no strategic vision. Indeed, telemedicine is a matter of concern for states, regional trade blocks (European Union, Mercosur, Alena) and international organisations such as: the World Health Organization (WHO), the World Trade Organization (WTO), the International Telecommunication Union (ITU), UNESCO and the World Bank.

The World Summit for the Information Society held in Tunis last November committed ITU's members to 'build a people-centred, inclusive and development-oriented Information Society, premised on the purposes and principles of the Charter of the United Nations, international law and multilateralism.' However, international health law remains the main source of legislation with different texts related to the human right to health or bioethics. Moreover, international labour law, international criminal law, international economic law do contribute to the emergence of a legal basis to approach the e-health 'nebula'. The fragmentation of legal sources is a result of the various objectives assigned to these organizations: protection of health, development of trade, etc...

From a systemic viewpoint, the interests on telemedicine and its applications are not the same in developed or developing countries. While developed countries discuss the cost-effectiveness of telemedicine, developing countries need to access rapidly tele-consultation and medical training via e-learning. In addition to this North-South divide, markets are still in their infancy and wonder how to develop their potential. The private sector interests contrast with those of Non Governmental Organisations which are in the position to defend patients' rights.

There is a lack of methodology and an urgent need for international cooperation and better dissemination of existing information: make an inventory of the current situation with regard to the international legislation, identify gaps and priority areas and identify common subjects to avoid duplication of work. This will make telehealth a real success as improved quality and access to care at a lower cost and without raising professional objections.

Ref: ITU, Tunis Commitment, Document WSIS-05/TUNIS/DOC/7 –E, 18 November 2005

Keywords: cooperation, cyberspace, international, law.

INTERNET BASED TELE-REHABILITATION VIDEOCONFERENCING SYSTEM

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Rehabilitation therapies teach people with musculoskeletal disorders how to compensate or regain function. There are some difficulties to establish telerehabilitation therapy as access to IT device, computer skills, etc. During winter, particularly strong and cold, many patients disappeared from outpatient rehabilitation centers. Physiotherapist appearing on the computer screen or mobile device display seems to be a very attractive opportunity for many patients. Certainly, some of rehabilitation sessions require direct physiotherapist presence but in other session dominates supervising role of the physiotherapist. The remote sessions may run utilizing teleconsultation network. Therapies are provided over a relatively long period of time to improve the patient's endurance and strength. Telerehabilitation holds great promise also for institutionalized patients who have provided these therapies at a setting which is under medical (nurses, nursing assistants) control (a nearby ambulatory clinic, the nursing home, etc.).

Material and method: Two different research approaches were undertaken during the study. The one was to review consecutive patients in out patient orthopedic clinic about their attitude to telerehabilitation. The second was to test the quality of available technologies in use for telerehabilitation sessions. Recently, a new software paradigm has been developed for providing telerehabilitation sessions. A selected group of patients was instructed how to use the application. All those patients were familiar with personal computer use and how to browse an internet. The Macromedia Flash Player was set on both sides of videoconferencing system. The Real Time Messaging Protocol was implemented for multimedia communication. Currently, two-way system of communication allows the patient to follow the therapist instructions and direct inspection of exercises by the therapist utilizing web cameras. We have tested usefulness of desktops, laptops and WLAN connected personal digital assistants and Flash Player operating mobile phones to create patients terminal.

Results: Two hundred patients (117 females, 83 males) were asked about their preparedness for tel-

erehabilitation. Their average age was 53 years (15-83). Only 30 declared e-mail address. More than half of the group declared an easy access to PC (54, 5%), but only 3 have had web camera. The popularity of mobile phones could be noted recently. Seventy-six and half percent of our patients were mobile phone users. Almost 40% of patients were determined to use internet-based telerehabilitation. All of those attempts to telerehabilitation (desktops, laptops and WLAN connected personal digital assistants and Flash Player operating mobile phones) were evaluated positively by both kinds of users. However, they confirmed some obstacles and inconveniencies previously premised.

Conclusion: We conclude that use of telerehabilitation via internet may significantly improve the process of function regaining with additional possibilities for joining leading physician during such sessions. Remotely controlled rehabilitation may also overcome patient's absence in outpatient offices during bad weather conditions and also to reach the most distant patients.

Keywords: Telerehabilitation, Macromedia Flash Player, videoconferencing

IT IN HEALTHCARE OF DEVELOPING COUNTRIES: MOLDOVAN EXPERIENCE

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Republic of Moldova, as developing country faces a series of health crises including hepatitis, tuberculosis and HIV/AIDS that threaten the lives of millions of people. Lack of modern technologies, infrastructure and trained, experienced staff are considered important barriers to scaling up healthcare level in Moldova.

Implementing IT in health care is an effective way of solving various problems of diagnostics and treatment. After studying the best practices and most efficient models used worldwide the National Conception of Medical Integrated System was elaborated. This National Conception laid the foundation for all the projects dealing with IT in health care.

Taking into account scarce financial resources Moldova chose the way of developing a basic informational platform – electronic medical records, the structure of which allows expanding and replicating, depending on the field used. This innovation makes possible the automatization of any kind of activity, performed in a medical institution and is directly related to the enterprise pharmaceutical companies and National medical insurance company.

At present, following the Conception of Medical Integrated System, a project, dealing with the creation of a National network of perinatological services, has been launched successfully.

Keywords: Developing countries, Conception of Medical Integrated System, Electronic Medical Records

LUXEMBOURG HEART FAILURE PROJECT, A NEW CONCEPT OF HOMEMONITORING FOR PATIENTS WITH CONGESTIVE HEART FAILURE

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Epidemiological background and public health relevance: Congestive heart failure (CHF) has become a health problem of epidemic proportion. Due to results of SHAPE (Study on Heart failure Awareness and Perception in Europe) 3.6 million new heart failure cases are reported each year in Europe. About 14 million people in Europe are affected today and this number will probably increase to 30 million by the year 2020. CHF-related hospitalisations have more than doubled in the last 20 years. Heart failure patients experience a lower quality of life than patients suffering from any other chronic disease. [1] In France the costs of treating heart failure are estimated between 109-208 M? every year. [4]. The German heart foundation reports, that Germany spends approximately 286 M? per year on the treatment of about 1.5 million heart failure patients.

IT-supported managed care: Better methods of secondary prevention are urgently needed to reduce life threatening situations and health care costs. In most cases a conventional pharmaceutical therapy has only modest effects on morbidity, mortality and quality of life [2]. Because of the limited number of donor hearts, cardiac transplantations are limited to younger patients. Recent studies have shown that re-admission, length of stay and hospital charges are significantly decreased when telehomemonitoring is embedded in well-adapted managed care programs [3]. It is assumed that

reduced re-admission rates will also have a positive effect on the quality of life.

The Luxembourg Heart Failure Project (LuHF) has developed an integrated home monitoring solution, based on a patented data analyse method to estimate the patients health status at distance. To minimize risks for the patients, the health estimation will be based on a set of physiological parameters. One important requirement is, that elderly and disabled patients may use this system easily, without the help of a health professional.

Methods: The LuHF team has developed a tailormade Monitoring Instrument for Cardiology (MonICard), able to record a one-minute Electrocardiogram (ECG) synchronic to the patient's oxygen saturation (SPO2), supplemented by noninvasive blood pressure (NIBP) and weight. A secure data transmission to the patented MonICard Analyse Unit will be followed by a remote estimation of the patient's health status, based on computed health indicators (e.g. Pulse Transit Time (PTT)). First results with a limited number of inpatients have shown, that this method allows it to react on early health fluctuations. Today, the system will be evaluated with CHF-patients (NYHA Class III-IV) in Luxembourg and two university hospitals in Germany and France. Events such as death, readmissions and hospitals days will be recorded. A health economic evaluation will estimate effects on quality of life and health care costs.

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Keywords: tele-home monitoring, managed care, congestive heart failure, MoniCard

MOBILE PHONE VIDEOCONFERENCING AS A TOOL FOR RAPID FIRST LOOK DIAGNOSIS

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Introduction: Physicians involved in treatment of injured patients require fast access to medical images. There are still some hospitals without integrated informatics network, but located within area covered with 3G network. Nowadays diagnostic equipment used for diagnosis of politrauma patients generates large number of images. Dramatic increase of image number was observed at the time of introduction of multislice CT scanners. One examination can contain several hundreds of images. The facility is located in several separated with no unified HIS-RIS network. The purpose of the study was to test video calls possibilities in management of multiply injured patients to speed up diagnosis during services.

Method: We performed video conference calls total time 240 min, using mobile phones Sony Ericsson K600i for verbal communication and image transfer between consultant radiologist and trauma surgeons. CT scans were captured from CT workstation equipped with LCD displays immediately after CT examination with 1.3 megapixel camera mounted inside the mobile phone and transferred to the recipient. Mobile phones that were used in this project were equipped in a relatively small LCD display width – 176 x height – 220 pixels.

Results: We have observed no telecommunication problems during video calls. Small objects were seen more clearly (e.g. single CT scans) in comparison to conventional, normal size X rays. We found especially difficulties of assessing pictures with high contrast between elements resulting in blurring of the object edges and averaging of neighboring structures that were displayed in form of large rectangles in various shades of gray.

Conclusion: Video calls utilizing mobile phones equipped with cameras for video conferencing can be used as an efficient tool facilitating rapid diagnosis in politrauma patients. The first look on medical images via video call may fasten introduction of some surgical procedures. The positive impact on image quality transmitted via video call should be expected with modern technology introducing 2 and more Mpixels cameras and optimally bigger screen in phoning device like in PDAs.

Keywords: Video call, teleconsultation, trauma patient

NEW TELEMEDICINE APPROACH TO ROUTINE SPORTS MEDICINE PRACTICING WITH MOBILE TOOLS

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Physiological endurance testing remains the one of most important tasks for Sports Medicine. Those tests remain crucial for sportsmen, coaches, physiologists and sports medicine specialists. Regular exercises may improve biologic age of active person but also decrease significantly the risk of hart, metabolic or musculoskeletal disorders. Regular exercise attraction serves as an integral part of either prophylaxis or rehabilitation. The most indicated forms of physical activity are walking, jogging, swimming, cycling, rowing or long distance skiing. Walking or jogging does not require too much specialized training or skills. Many tests were developed for aerobic endurance evaluation during simple activities. Most of them are age independent. Part of those tests does not require specialized equipment and laboratory environment. Currently mobile phone with specialized software may serve instead of simple equipment required for such testing. Mobile phones are used now not only for communication, but often for replacement of other electronic devices for work and entertainment. Most of all manufactured phones are designed to create and run software written in Java. That makes easier to extend mobile phones functionality. PulseTester seems to be the first application developed for mobile phone, allowing simple physiological tests performance without other additional equipment. Results could be stored in the phone's memory or send via GPRS and stored on special server for further retrieval and analysis. An application was implemented in J2ME technology. It may operate on almost all mobile phones with implemented Java. The presented application may serve for sportsmen evaluation but equally for elderly and disabled. Transmission via GPRS and storage of data on server opens the possibility of physical ability monitoring.

Keywords: Physical endurance testing, mobile phone, application, monitoring

NEW WAYS IN TELEMEDICINE – EXPERIENCE OF 2005

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The modern telemedicine uses a lot of technological and telecommunication decisions, which allows to achieve mobility, interoperability, clinical and non-clinical efficiency. We undertake steps in development of new directions in the telemedicine (in 2005).

1. Mobile telemedicine: Classical mobile telemedicine means usage of portable mobile computer sets with medical equipment and satellite links. Such systems usually use in military medicine, during technological and ecological disasters, on transport. By the other hand, the modern medical doctor is very active in daily clinical practice. So, the new conception of mobile telemedicine means quickly, easy and useful access to telemedical technologies during need able time, in need able place. The telemedicine should be in the pocket of the doctor's dressing gown near to stethoscope, pencil or scalpel. Development and wide improvement of mobile technologies (PDAs, smart- camera phones, communicators, GPRS Internet etc) allows medical doctors to be on-line 24 hours per day. During 2005 year we were used system of mobile telemedicine which consist from: PDA, mobile phone with digital photovideocamera (640x480) and GPRS Internet. It is sys-

tem for "telemedicine in dressing gown's pocket" – anytime and anywhere (ward yard, surgery room, car etc) medical doctor can lead telemedical procedure. With this mobile telemedicine system we had lead 10 teleconsultations (urgent traumatology and maxillo-fascial surgery). We were used e-mail, MMS/SMS messages. Results – high relevance of teleconsultations, 80-90% of diagnostic accuracy, economical and clinical efficiency.

2. Telemedicine for rural areas: In many countries of the world quality of medical care in the remote and rural areas remains on the low level. It is possible to tell, that the rural doctor remains the basic consumer of telemedical services. So, development of special decisions' sets is necessary for most effective improvement of the telemedicine in rural areas. Our recommendations on self experience: 1) Telemedical work stations (PC, digital camera, dial-up Internet). 2) Mobile phones with message services (MMS/SMS) and digital cameras, especially for urgent teleconsultations. 3) GPRS Internet is an effective alternative to usual links. Because, in the remote rural areas quality of ground telephone communication lines very low also does not allow to use dial-up; leased lines usually are very expensive. 4) Using of web-platforms for teleconsultations (for example, iPath of Basel University is used as the web-platform for the Donetsk Regional Telemedical Network). We are organize a telemedical network, which include regional center and 3 remote station in rural areas. 19 teleconsultations were lead. Results – high relevance, economical efficiency.

3. Home telemedicine: Development and improvement of home telemedicine – one of the most important directions of modern eHealth. First time in Ukraine we were used system for blood pressure and heart rate home telemonitoring kindly given to us Melexis™ company. System consist from: BP monitor, I-modem, ROS-server. We had been organized experimental (trial) home telemonitoring for 7 patients. Research of patients' satisfaction has shown a high system effectiveness. Attention – at present (trial) stage the system was not used for diagnostics and treatment.

More information: *www.telemed.org.ua, http://telemed.ipath.ch, www.melexis.nl.*

Keywords: telemedicine, mobile phones, MMS, home telemedicine, urgent teleconsultations

NFC – THE INTUITIVE LINK BETWEEN PEOPLE AND eHEALTH

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Using the mobile phone as a patient terminal in home monitoring applications introduces new possibilities in the management of chronic diseases where consequent recording and monitoring of health-related data is important. In such concepts, the most challenging part still is the patient terminal, i.e. the way data are entered into the system. Up to now, there is no method available which fulfils all criteria of an ideal patient terminal in terms of usability, adaptability, flexibility, and last but not least in terms of costs. However, the now available NFC – technology combined with NFC enabled mobile phones has the potential to improve the situation with respect to those critical features.

Near Field Communication (NFC) is a short-range communication technology which evolved from a combination of contactless identification (RFID) and interconnection technologies. The basic idea of NFC is to enable data exchange between two devices within a range of centimetres in an intuitive, easy to handle, and secure way. In order to make two devices communicate, users are to bring them close together or even to make them touch. Data exchange starts automatically without the need of user interaction and configuration.

To explore the feasibility of the NFC technology in the eHealth domain an all-purpose NFC module has been developed which can easily be integrated into several medical measurement devices like blood pressure meters. It features an embedded microcontroller to fetch the data from the device and to provide them via the NFC module. Additionally, a timestamp and a unique devices ID are included. After the measurement, data can be accessed simply by touching the medical measurement device with a NFC enabled mobile phone – at the point where the antenna of the NFC module is located, Once the data have been captured a special Java-based software running on the NFC enabled mobile phone triggers data transmission over a mobile communication network to the remote monitoring centre automatically without the necessity of any further user interaction.

A working prototype has been developed by integrating the developed NFC module into an off-the-shelf

available blood pressure meter. Initial tests indicated that – compared to other methods like entering data via the mobile phone's numerical keypad – NFC technology provides the following advantages:

- Personal health data can be captured in an intuitive, automated and error prone way but still having the patient in control of the data acquisition process
- There is no need of cumbersome user interaction and configuration procedures

Standardised interfaces make the NFC module adaptable to several medical measurement devices. In the future various mobile phones will be equipped with NFC interfaces which will make NFC technology ubiquitous available at low costs.

In summary, NFC technology has the potential to act as the intuitive link between people and eHealth concepts. Particularly elderly and technical unskilled people may benefit from NFC technology allowing them to capture their health-related data in home monitoring scenarios.

Keywords: NFC, Patient Terminal, Home Monitoring, Mobile Phones

NINE-YEAR EXPERIENCE IN TELEMEDICINE FOR RURAL & REMOTE DISTRICTS OF RUSSIA: FROM TELECONSULTATIONS TO e-DIAGNOSTIC CENTERS

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Now the base trend in development of medicine in Russia is family medicine. So the Doctor of general practice will be the main figure in medical points of Russia's rural & remote districts. It means transition to international principles of health care delivery shifting the focus to primary health care (PHC).

We think that only new information technologies and first of all the telemedicine paves the way for success of State medicine policy.

Starting in 1997 from simple web cameras and ISDN telephone lines between Moscow and Perm today we have three levels All-Russian videoconference network with more than sixty telemedicine points in rural & remote districts of the country. Each telemedicine point usually is placed in regional or district hospital and has the art video conferencing system and ISDN or IP channels (or both) and sometimes Space Satellite channel. The special software has been designed and implemented for control of the teleconsultation process.

We have a good experience in a properly selection of equipment for new telemedicine points. Specialists of Russian Society of Telemedicine always tests modern units and offer members of our network for choice possible scale of equipment. This way support full compatibility of equipment and gives possibility connect with all telemedicine points in the network.

We suppose that telemedicine points in district hospitals (third level of network) will be the base for doctors of general practice IT support. Of course, their material and technical base will be improved allowing implementation of new treatment and diagnostics technologies.

It means that each physician Health Center in Russia's rural & remote village have to be equipped with a set of diagnostic units compatible with digital telemedicine equipment in this Center or special digital converter that will support full compatibility of equipment has to be installed.

The main list of diagnostic units must include simple and complicated one: Digital stethoscope, Blood Pressure Measuring Device, Weight Meter, Glucose Meter, Blood Oxygen Saturation Level (SpO2) and Respiratory Flow Meter up to ElectrocardioMeters, EchocardioMeters, Ultrasound digital equipment and so on. Only images of rays will be scanned, compressed and sent, but maybe digital and not very expensive x rays equipment will appear in the market very soon. The list is not closed and will permanently change. Of course this diagnostic and IT complex have to be controls by the new designed software. We hope that our experience in selection of diagnostic equipment for mobile telemedicine stations will help us exclude serious mistakes in this way for PHC.

It is our hope that within the next few years there will be telemedicine units in most parts of rural and remote districts of Russia. Feasibility studies have been completed and the first phase of execution is starting in frames of Federal Program "The Electronic Russia".

What is still required is not implementing better technology and getting funds but changing the mindset of the people involved.

But it is subject for another discussion.

Keywords: telemedicine, network, remote regions, PHC.

ON THE HORNS OF A DILEMMA: TELEMEDICINE FOR AFRICA?

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Telemedicine is proposed as a solution to many problems of healthcare delivery to disadvantage communities and countries. Is telemedicine a practical solution for Africa? Africa is faced with the triple burden of disease, tuberculosis, malaria and HIV/Aids, exacerbated by poverty. Despite this, it is projected that the population of Africa will more than double by 2050.

Does Africa have the capacity to manage the healthcare of this growing population? Sub-Saharan Africa has relatively few medical schools and there is also the ever present brain drain of doctors and healthcare workers from Africa to the developed world. Countries like Italy and Cuba have over 500 doctors per 100,000 population and America, as a benchmark, has 279. In sub-Saharan Africa the picture is somewhat different. In 29 of the 49 sub-Saharan African countries there are less than 10 doctors per 100,000 population.

Can telemedicine provide a solution? Existing sustainable models of telemedicine are largely based on fee for service models or are donor funded. Is Africa able to buy itself out of its shortage of doctors? The gross domestic products (GDP) of sub-Saharan African countries are significantly less than those of the developed world. To compound the problem, African countries allocate a smaller percentage of their GDP to Health. While governments of countries like Canada and America spend $1,500 – $2,000 per capita per annum on Health, several African countries allocate less than $10 per capita per annum to Health. Africa is not in a position to buy telemedicine services from the developed world.

It could be argued that if an adequate telemedicine infrastructure is established in a country, this would lead to an improvement in the provision of services. Telemedicine infrastructure comes at a cost – not only the setup cost but the ongoing cost of ownership. Even simple, apparently cheap solutions like of email based store and forward telemedicine are not necessarily so simple or cheap in Africa. It is estimated that the total cost of internet access in the USA is about $20 a month, while in Africa the average cost is estimated to be $60 per month, and this is not for broadband access. Even at the level of email, there is the risk of the cost of the service jeopardising healthcare, if ICT infrastructure is funded from Health budgets. Costs increase greatly with videoconference-based telemedicine.

Technical standards are also an issue. Existing standards for images are first world based. Is a email service based on digital photographs of XRays, which do not meet international standards, unacceptable, or is something better than nothing? What are the ethical implications of lowering standards? Are there any solutions for Africa?

What is required are innovative approaches to the development of new financial models for international telemedicine, new standards and ethical guidelines for the practice of telemedicine in developing countries and new paradigms for the provision of medical education across international boundaries. Sub-Saharan Africa needs to try to find its own solutions to its medical service and education problems with the support and assistance of the international community.

Keywords: Africa, telemedicine, medical education

OPHTHALMIC POST-GRADUATE TEACHING IN IRELAND: THE EXPERIENCE USING VIDEOCONFERENCING AND COLLABORATIVE TECHNOLOGIES

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The presentation describes the experience during the last two years in expanding the regional reach of the Seminar Series of the Ophthalmic Post-graduate Teaching Programme operated by the Royal Victoria Eye & Ear Hospital (RVEEH) centrally located in the capital city of Dublin, through the use of high quality audio and video-conferencing and collaborative technologies.

The presentation outlines the approach taken in developing an Information and Communications Technologies (ICT) enabled model of instruction, to meet the pedagogical needs of (i) the programme

administrators, (ii) the presenters of both clinical cases and specialist topics and of (iii) the medical participants. The initial testing and validation of the pedagogy and technology commenced in late 2003 between the national Health Services Executive (HSE) facilities in Dublin and Sligo General Hospital some 220 kilometres away in the north-west region of the country. The region had an infrastructure and skills for piloting innovative telehealthcare systems which was drawn upon. The participants were surveyed after the initial seminars and high satisfaction rating were achieved. Following successful experiences further regional sites -the Letterkenny General Hospital and the University College Hospital Galway were added in turn. The educational and technical experiences have again proved very positive and were reconfirmed by a 2005 year-end survey.

Technical testing, guidelines and dry-runs for presenters are an established feature of pre-seminar activity. Being a teaching programme there is a changing stream of medical specialists to speak and a periodic turnover of junior doctors that present their clinical cases. Twin screens are used at each location to separately and adequate displays of (i) continuous audio-visual (A-V) of the speakers and (ii) data/teaching materials. From a technical perspective, the inclusion of high quality clinical ophthalmic content (still images and digital video) presented a particular challenge. Several different methods for transferring and synchronously sharing lecture materials were progressively evaluated before satisfactory collaborative software was found. The A-V technology employed is based on high quality audio (G.722) and video (H.263) using an Integrated Services on a Digital Network (ISDN) connection (384 kilobits/second). The success achieved has resulted in emphatic requests for participation from more regional hospitals. Recent activity includes preparation of additional sites with sponsored access to a Virtual Private Network (VPN) with 12-way video-bridging facilities handling the mixed Internet Protocol (IP) VPN and ISDN connectivity capabilities to 2 megabits/second.

The presentation includes treatment of the pedagogical, technical, procedural and other experiences, the results achieved and the conclusions drawn from the service development to date.

Keywords: Distance Education 1, Ophthalmic 2, Video-Conferencing 3, Collaboration 4

P.O.CA.HO.N.T.AS (POINT OF CARE HOME NETWORKED TELE ASSISTANCE): AN EXAMPLE OF HOSPITALIZATION IN THE TERRITORY

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Today in Italy each district of territory requires many interventions planned *home assistance integrated*, making more widespread use of Telematics, particularly those of Telemedicine. The home care assistance is increasing and the operations at home more and more are rising advantages for the Patient and the Continuity Care.

In the present text, the Authors illustrate a project: P.O.CA.HO.N.T.AS., (Point Of CAre HOme Networked Tele ASsistance), is a real service at home of the Patient, particularly terminally ill, through the utilization of telematic technologies: many healthcare services, in short. A very diagnostic tele-assistance at home, recording of biomedical parameters and test of laboratory that are transmitted to the hospital center.

P.O..A.HO.N.T.AS. realizes a model, a system, a methodology, to guarantee the continuity of care. The model is an operating system among the principal subjects: Patient, Physician, Hospital. Characteristics are:

- a mutimedia little bag for diagnostic examinations and test of laboratory at home;
- an integration of information in network online with healthcare center of excellence (Istituto Nazionale Tumori of Milan), structured in an Virtual Ambulatory Oncology at Home (AVOD).

The operative model can be moved in different pathologies, environments and territories. Specified characteristics are:

- the flexibility: the utilization of systems in different and ordinaries applications in hospital and in emergency;
- employment level: new professional roles and training programs.

In P.O.C.A.HO.N.T.AS. there is a computerized file by these objectives:

- to standardize the healthcare clinic process;
- to monitor the clinic activities by different ratio;
- to improve the efficiency and the timeless of an intervention;
- to share the informations on-line and to promote the teleconsultation among Physicians and professional operators;
- to access data base by the palm of the medical operator and to insert new data about the clinic process of the Patient.

If the results will be very positives it's probably that this system will be extended in Lombardy Region and after in other Regions of Italy.

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Keywords: Call Center, Emergency, Healthcare online, Telemedicine; Telediagnosis

PARKSERVICE: HOME TELEMEDICINE AND WALKING AID FOR PARKINSON'S DISEASE.

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PARKSERVICE is a telemedical service integrating home support with a ground-breaking walking aid for people with Parkinson's disease (PD). PD affects 2 in 1000 of the general population (von Campenhausen et al. 2005). Nine years after onset 80% of subjects are no longer capable of work (Dodel et al., 1999). This creates a large isolated home-based population. The management of this group is complex and requires periodic assessment from specialist therapists. Symptoms can vary throughout the day ("fluctuating PD"), may include unpredictable sudden immobility ("freezing") and are complicated by side effects of the drug treatment. Fortunately clinical support of PD can be performed remotely (Wilson, 2004).

PARKSERVICE provides a home-based service supporting the clinical management of PD and the social inclusion of patients. Using the television as user interface and DSL internet connection, PARKSERVICE allows people with PD to create videos of themselves, either as messages to others or as a particular record of symptoms for clinicians. Videos are silently uploaded to a secure server from which the user can control access by other PARKSERVICE users. Text-messaging and symptom diaries are also available.

Moreover, PARKSERVICE supports INDIGO, a wearable augmented-reality mobility aid that dramatically improves walking in certain people with PD. Using virtual reality glasses and bespoke portable electronics, INDIGO overlays a video of "visual cues" (*e.g.* scrolling black & white stripes) onto the normal view of the user. In the presence of visual cues suitable subjects break out of freezing phases and walk near-normally (Lewis *et al.* 2000). In earlier R&D work (EU PARREHA project IST-12552-1999) PARKSERVICE partners found visual cues should be customised to the user and that this can also be performed telematically. PARKSERVICE integrates a service to people with PD at home and their clinicians, exchanging text and video, experimenting with visual cueing and supporting the use of INDIGO through the television.

PARKSERVICE is currently being validated across Europe via funding from European Commission e-Ten initiative (C517382) with pilot sites launched in April 2006. INDIGO is also undergoing clinical trials at the Institute of Neurology, London supervised by Prof. M Jahanshahi. INDIGO won the EU "New Territory" prize for Assistive Technology in 2004.

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Keywords: Parkinson's disease, home care, walking aids, telemedicine

PROGRESS OF E-HEALTH IN AUSTRALIA: HEALTHCONNECT

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Health*Connect*, a Health Information Network for all Australians, is the National e-Health model. It is a joint Australian, State and Territory Governments initiative.

This paper presents a short report on Health*Connect* and it attempts to cover Health*Connect* trials throughout Australia. Contents: The timeline of Health*Connect*, Brief description of the Health*Connect* project, Key sections of Health*Connect* project, and Health*Connect* trials throughout Australia.

Note: This is the fifth paper among a series of six papers; and some contents of this paper were presented at the public seminar "Progress of e-Health in Australia: 20 years of achievement", for the Health Informatics Society of Australia (HISA), at the Western Australian Department of Health, East Perth (WA).

Keywords: EHR, e-Health, Medi*Connect*, Health*Connect*, EHR*net, openEHR, CHORd, HC-CIP, Provider*Connect*, National Health Privacy Code, EAN, ACOM.

PROGRESS OF E-HEALTH IN AUSTRALIA: OACIS (THE OPEN ARCHITECTURE CLINICAL INFORMATION SYSTEM)

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Providing healthcare services to its citizens is government's responsibility and only a seamless integration of facilities between healthcare service providers can deliver this better. Clinical Information System (CIS) is a key component of any e-Health model.

This paper portrays Oacis Programme as a state of the art implementation by the South Australian Department of Human Services (DHS). It also touches topics related to Health*Connect*, the Health Information Network for all Australians. vOACISTM, the EHR solution from DINMAR (Canada) has also been explained. Contents: CIS, History of the Oacis Programme in South Australia, vOACISTM: an EHR solution from DINMAR, Implementation of the Oacis Programme, How 'Change' was managed under the Oacis Programme, Areas where the Oacis Programme influences Health*Connect*, and Oacis Programme Vs Health*Connect*.

Note: This is the last paper among a series of six papers, and contents of this paper were presented at the public seminar "Reviewing the South Australian OACIS Model (Open Architecture Clinical Information System)", for the Centre for Health Informatics Research and St John of God Health Care, at St John of God Health Care, Subiaco (WA).

Keywords: EHR, e-Health, Open Architecture, CIS, OACIS, Health*Connect*.

PROJECT DESCRIPTION AND OVERVIEW – DOC@HAND

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In a scenario where Healthcare organizations tend to rapid decentralization, with multiple actors involved in the care delivery processes, the importance for professionals to collaborate, access and share data and knowledge becomes more and more stringent.

Doc@Hand aims to support Healthcare professionals in day-by-day activities collaboration offering full access to shared data information and knowledge, help them in reducing time and associated costs to collect the information and knowledge needed for a more informed decision making (diagnoses, therapies, protocols); it provides an intuitive interface for accessing to widely spread information through natural language queries using mobile devices such as laptop, pad, smartphone, etc. This presentation will provide an overview of Doc@Hand consortium, architecture, features and goals.

PURCHASING COMPUTER PROGRAM (APPLICATION) FOR HEALTH

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At a time when health institutions and health workers are purchasing not only hardware, but are also actively purchasing the accompanying software, they should have some specific knowledge how to avoid unforeseen costs or unexpected difficulties (delays, narrowing of programme use possibilities etc.).

The paper offers rules and recommendations to follow in software purchases. It focuses on the content of tender documentation, method of purchase, offer assessment criteria, buyer's involvement in programme development, software ownership, specification of requirements, trial run and its assessment, selection of application builders (not of their providers), multifunctionality of the programme, selection of technology, and the norms and standards recommended for applications.

Tackled separately is the content of purchase contract. The contract should be brief, clear and invoking contract annexes that present in minute detail and accurately the respective rights and obligations of the purchaser and provider. These annexes are technical description of the solution and scope of work, specification of software deliveries and servicing, delivery organisation and schedule, division of responsibility, price specification, method of payment, takeover procedure for the work completed, maintenance and support, time limits and conditions applying to the use of intellectual property rights, etc).

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Keywords: computer program, purchase, tender documentation, health, contract

REINFORCEMENT OF TRANS-THEORETICAL MODEL ON EXERCISE BEHAVIOR WITH RADIO FREQUENCY IDENTIFICATION TECHNOLOGY

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Physiology shows that regular moderate exercise can improve health and physical fitness, whereas chronic diseases cause the major health problems in industrialized countries increasingly. This phenomena indicates that shifting of personal exercise behavior is still a big challenge, although the benefits of exercise are well-known.

Many studies reported that 50% of participants may drop out the exercise program within the first few months and concluded that a longer duration is required for exercise behavior change. Meanwhile, according to trans-theoretical model, it is crucial to provide the relevant record and information during the pre-contemplation and contemplation stages for any exercise behavior change program. Beside these two basic requirements, labor-less and time-flexible properties are also required for modern exercise management. This paper illustrates the principle and implementation of an information system based on RFID (radio frequency identification) technology, attempting to resolve the difficulties encountered in implementing exercise behavior change program. With this system, participants can acquire information of exercise (running time, speed, frequency etc.) and fitness change through the Internet or email actively or passively. In addition, deducted personal interest data, statistic, and recommended exercise

prescription are also provided. A survey shows that this strategy incurs college students' interest and the effectiveness in regulating their running activity can be further studied.

Keywords: Trans-Theoretical Model, Exercise Behavior, Radio Frequency Identification (RFID)

RIVER HEALTH: DESCRIPTION OF AN INTEGRAL HEALTHCARE PROGRAM IN A REMOTE RIVER BASIN OF ECUADOR

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The province of Morona-Santiago is probably the most isolated in Ecuador; furthermore, its Eastern zone has practically no roads, and the only means of access is by small aircraft to rudimentary airports in the jungle. The villages are linked through a rich network of rivers. The health situation is appalling and healthcare is precarious. Malnutrition, parasitism, tuberculosis, malaria, hepatitis and other diseases are prevalent. Therefore, we believe it is necessary to organize a fluvial healthcare unit in coordination with fixed health posts as a system to deliver health to the area.

In April 2001 navigation of the main river, Morona and its effluents by motor powered canoe was completed in an attempt to chart the river path by GPS, and to determine adequacy of depth and width throughout the watercourse. Agreements were signed between the central and local governments, private companies and NGO's for the financing, construction, equipment, administration and execution of the project.

We have been offered to utilize satellite technology to determine river conditions to help in assessing operability and safety of the fluvial unit.

A multidisciplinary team in conjunction with the natives will elaborate a model of development for the area with minimal infringement of the fragile Amazonian ecosystem. The integral health program will include: health information gathering, immunization, growth and development, prevalent diseases of infancy and school aged children, sexual health and reproduction, geriatrics, oral and mental health, education for basic sanitation, and compilation of traditional knowledge regarding medicinal plants and their application. We will also have intermittent surgical brigades 3-4 times a year depending on the pathology found. To facilitate the implementation of the program we will make use of Telemedicine for consultation and support from the CINTERANDES foundation headquarters in Cuenca and MITAC in Richmond, Virginia.

The results of our efforts so far have accomplished the foundation on which the program will build on. We produced an accurate map of the river conditions in conjunction with the location of the villages. The extension of traversable river is approximate 100 Kms, with an estimated population of 5,000-10,000. The fluvial unit was built in Ecuador and contains an operating room, recovery room, a consultations office and living quarters. It is capable of negotiating the charted channels. We anticipate the project will be activated in mid 2006 and its results will be reported thereafter.

Keywords: River Health, Healthcare, Integral Health, and Telemedicine.

ROLE OF TELEMEDICINE IN DELIVERING HEALTHCARE IN REMOTE AREAS OF A DEVELOPING COUNTRY

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Telemedicine, as the name implies, is medicine delivered across a distance.

It essentially means that the patient and the healthcare provider are separated physically. In Telemedicine, the information moves, rather than the doctor or the patient. The information may include medical images, live two-way audio and video, patient medical records, output data from medical devices and sound files.

Telemedicine is a revolutionary concept in health care as it saves lives by providing timely healthcare, reduces both the geographical limitations and the cost of treatment along with improving the quality of medical care.

As Telemedicine is all about patients and their benefit, the applications should always be need driven as opposed to technology driven. With this

premise, Pakistan's first Hub & Spoke/s model of Telemedicine is established in the province of Sindh connecting 2 primary/secondary care hospitals in the rural areas to a tertiary care center in Karachi. With a population of more than 145 million people Pakistan only has around 13000 specialists in all fields and around 110000 registered doctors. This scenario is compounded with the fact that the above number of doctors and specialists are not evenly distributed in the country but are saturated in 3 – 5 major cities. With the limited human and financial resources. The only solution to the exorbitant need for healthcare to the rural areas of Pakistan can be provided by Telemedicine.

The basic method is store & forward Teleconsultation but real time videoconferencing is also available for selected patients.

The essential Telemedicine applications in this model include:

- Teleradiology
- Teledermatology
- Telecardiology
- Telemedicine for all major diseases covered in internal medicine

The model also includes distance learning module for doctors present in the remote hospitals.

RURAL TELEMEDICINE: LESSONS FROM ALASKA FOR DEVELOPING REGIONS "TELEHEALTH IS ABOUT PEOPLE AND PROCESSES, NOT JUST ABOUT THE TECHNOLOGY."

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Alaska shares many characteristics with many other rural and remote regions of the developing world, including a small population spread over a large area, lack of roads linking villages to hospitals, a significant indigenous population, and a shortage of doctors in rural areas.

Communication with village health aides was originally by high frequency (HF) radio. Satellites brought reliable voice communication in the 1970s. Alaska has now introduced the first permanent upgrade to the voice satellite system to provide data connectivity and applications for village health clinics, known as the Alaska Federal Health Care Access Network (AFHCAN). This satellite-based system is now the world's most extensive telemedicine network, linking 248 sites, including 158 village health centers.

This paper examines the approach used to design the network, and includes preliminary findings on utilization of the network and associated cost-savings. It also discusses the U.S. Universal Service Fund subsidy for rural health care facilities and its policy implications for extending access to medical facilities. It concludes with lessons learned that could be applicable for other remote and isolated areas and developing regions.

SATELLITES AND HEALTH EARLY WARNING FOR ENVIRONMENTAL RISKS

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It has been definitively demonstrated that some important health outcomes are tightly associated with environment, weather, and/or climate. Among these are temperature-related morbidity and mortality, health effects of extreme weather events (storms, volcanoes, earthquakes, floods, droughts), air-pollution-related health effects, water- and food-borne diseases, and vector- and rodent-borne diseases. In order to predict and prevent these health threats, monitoring the environment and climate parameters and changes from the space is becoming mandatory.

The high amount of data provided by satellites can be used to set up HEWS capable of revealing any alarming data or changing trends and of rapidly communicating the alarm for adequate targets (centres, institutions, stakeholders). Satellite technologies can also be used in HEWS to centralise, make accessible and deliver databases to public health bodies, decision makers, and health information centres.

Moreover, the health outcomes derived from the accidental or deliberate release of biological agents, which previously was considered only as an unlikely possibility, is now seen as an improbable but very dangerous event possibly leading to disastrous consequences. For this reason, it becomes crucial to integrate a dedicated warning system into the global HEWS to improve preparedness.

The **use of satellites is mandatory** to create an Early Warning System capable of predicting communicable disease diffusion patterns, risk of disease outbreaks and extreme meteorological event related health threats on the basis of an enlarging database constructed by continuously monitoring the environment.

Moreover, the **transmission, in real time, of alarming data via satellite** would allow prediction to occur in times compatible with the setup of adequate protective measures for the safeguard of the citizens' health.

Note: This study has been developed in collaboration with the Telemedicine via satellite Working Group

Keywords: Space technologies, satellites and health, prevention of environment-related health risks

SEAMLESSLY AND SECURILY SHARING HEALTH CARE DATA WITH TRIPLE SPACE COMMUNICATION

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The eHealth is a very demanding field populated by organizations of any dimension (form large hospitals, to small laboratories and even single practitioners surgeries) in which the common problems of any eBusiness scenario are amplified by the intensive use of knowledge, by accurately handling citizens' privacy and live or death implications. For these reasons, the actors involved ask at the same time for autonomy in information gathering and in decision making and for of completeness, accuracy and trustability of in the information exchanged. Autonomy induces heterogeneity whereas completeness and accuracy call for seamless and frictionless information sharing. For this reasons eHealth has been seeking for semantic interoperability for more then a decade.

An open challenge in eHealth is factually securely sharing health data among healthcare organizations providing authorized healthcare professionals with a complete array of patient information. Many standardization activities (such as HL7 CDA, openEHR, CEN ENV 13606 / EHRcom, DICOM, IHE) are addressing this problem but none of them has achieved the desirable level of flexibility.

TripCom is a European Commission funded 6th Framework Programme project starting in April 2006, which aims at developing an highly scalable, semantically enhanced communication infrastructure named Triple Space Communication. Such infrastructure is the result of the integration of Tuple Space, Semantic Web (triple), and Web service technologies. Tuple Space and Web services provides platform for application integration based on persistent publication. Semantic Web provide machine processable semantics in order to allow mechanized integration of services (data and processes). Decoupling communications TripCom will reduce (if not eliminate) the need for *a priori* knowledge of the partner and communication channel thus enabling multi-party interaction for free.

Sharing of health care data respecting parties' autonomy and citizens' privacy is a very demanding test-bed for TripCom infrastructure because it poses significant challenges in terms of

- Interoperability: TripCom should provide a distributed infrastructure that enables maximum decoupling (i.e. time, space, information schema and terminologies) between the various recipients that own the information (e.g. labs, GP's patient file, hospital information systems, etc.) and those recipients that need to elaborate such information (e.g. an application on board ambulance). In other words, TripCom is required to support different eHealth services (ranging from general practitioner electronic patient records to hospital information systems, including mobile device like those use by nurses in home caring) in writing information in a way that other eHealth services can later access such information without regards to the standard they implement (HL7, ENV13606, etc.).
- Information security and trust: TripCom should enable the enforcement of Authentication and Authorization rules in a distribute way which is not commonly available and quite worth in highly decentralized scenarios such as healthcare, in which every party involved is responsible for keeping the ownership of the data, but the health of citizens depends on the ability to trustworthy sharing data.

Keywords: Sharing health care data, Distributed Infrastructure, Semantic Web, Semantic Interoperability, Trust, Information Security

SEMANTIC CAPABILITIES BROUGHT BY DOC@HAND

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Nowadays, the huge amount of documents available made harder the retrieval of the desired information with a simple keyword-based query; then, there is a need of a more focused research trying to understand the real meaning of both document and query contents.

Researchers agreed the conclusion to add a kind of semantic capabilities to available resources (network information and knowledge), and Ontologies has been chosen as useful instruments to reach this goal because they represent 'an explicit specification of a simple and abstract world visualisation' where concepts and relations are well defined and explicated.

Doc@Hand can offer semantic capabilities thanks to a set of tools strictly interoperating each other for a better information retrieval (clinical records, guidelines, clinical cases, protocols, scientific publications, etc...) thanks to a search engine, a language parser and Ontologies; this presentation aims to explain how they work and what is the tangible benefits brought by the adoption of this technologies.

SPACE TECHNOLOGY TO MANAGE CONTROL INTERVENTIONS AND SURVEILLANCE OF VECTOR-BORNE DISEASES NATIONAL CONTROL PROGRAM OF CHAGAS DISEASE: SPATIAL IDENTIFICATION OF INFESTED HOUSES NOTIFIED BY COMMUNITIES UNDER ENTOMOLOGICAL SURVEILLANCE USING GPS TECHNOLOGY TO MONITOR AND DEFINE AREAS UNDER RISK OF RE-INFESTATION.

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Chagas disease is a Public Health problem in Paraguay. It is estimated that 400,000 individuals (6% of total population) are infected with the parasite Trypanosoma cruzi, transmitted by triatomines, bugs mainly present in rural areas. 344,048 dwellings in 3,653 localities distributed in 12 endemic departments were entomologically evaluated and sprayed in the last 5 years, and horizontal surveillance systems with community participation were implemented for the sustainability of the vector control activities.

Since 2003, Global Positioning System (GPS) is used by the Paraguayan National Control Program of Chagas Disease, and entomological database historically recorded was geo-referenced. Up-to-date, geographical localization and spatial distribution of infested houses in areas under entomological surveillance is used to visualize in maps the precise location of these houses, occurrence of re-infestations and the risk of infestation of neighboring houses.

The National Program evaluated areas previously sprayed using GPS in a retrospective analysis, detection of spots with conglomerated houses, considered such as new infested dwellings, were proven to be operational field failures performed in the past during vector control activities. Another advantage observed with GPS technology was the possibility to design operational strategies for vector control, programming number of personnel involved, time consuming and cost of transportation in hyper-endemic areas where very low density of dwellings are present (60% of the Paraguayan territory has 28,500 houses in 246,925 square kilometers).

This work was supported by UNDP/World Bank/WHO Special Programme for Research and Training in Tropical Diseases (TDR), and Canadian International Development Agency (CIDA).

Keywords: Trypanosoma cruzi, Triatoma infestans, Global Positioning System, Chagas´disease.

SSM LITERATURE REVIEW

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Soft Systems Methodology (SSM, Checkland, late 1970's), a socio-technical tool, has found a place in dealing with many complex situations, but is relatively unknown in the Health Sector. Aimed to find whether there lies any potential for using SSM in Health Business Environments, an extensive literature review was carried out at CHIR (Centre for Health Informatics Research, Curtin University of

Technology) on the use of SSM resulting in a collection of publicly available documents spanned for about two decades.

This paper, based on the publicly available literature, attempts to provide a picture on the worldwide use of SSM with specific reference to Public Sector and Health Sector.

Contents: Data collection, Data Organisation, and Findings & Inferences.

References:

P. Checkland and J. Scholes, Soft Systems Methodology in Action, John Wiley and Sons Limited, United Kingdom, 1996

Note: This is the first paper among a series of two papers; and the findings were put forward for the focus group discussion "Soft Systems Methodology for achieving successful technological adoption outcomes- History & Future" at the School of Public Health, Curtin University of Technology, Perth (WA).

Keywords: Soft Systems Methodology, SSM.

STRATEGY TOWARDS SUSTAINABLE SERVICES IN TELE-HEALTH AND TELE-EPIDEMIOLOGY

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Since 1999, CNES in the frame of the S2E consortium (Space Survey for Epidemies, gathering CNES, MEDIAS, MEDES, CLS, Institut Pasteur and Ecole Vétérinaire de Lyon) has been working with health professionals to consider how space-based systems could improve health care, notably through telemedicine applications. Potential users have identified two key areas: teleconsultation to ensure good-quality diagnosis for extremely isolated populations, and tele-epidemiology to combat deadly viruses and disease. Today, many case studies have proven the value and effectiveness of such systems:

- Teleconsultation

A number of space-based telemedicine networks have been set up recently to provide teleconsultations in dermatology, emergencies and tropical medicine. In French Guiana, a pilot experiment was conducted from end 2001 to the spring of 2002, with funding from the Ministry of Health, by Andrée Rosemont hospital in Cayenne and CNES, in close cooperation with the MEDES space clinic. Four health clinics at isolated spots in the Amazon jungle were supplied with telemedicine kits to be able to send imagery and digitized tests via satellite for dermatology, cardiology and tropical medicine. The results were so encouraging that the four sites have been made permanent, and the Ministry of Health and the European Regional Development Fund are providing funding to equip all of the 21 clinics linked to Cayenne hospital with a telemedicine kit.

Looking ahead, other telemedicine projects are in preparation. For example, the Ministry of Health has commissioned a study to deploy telemedicine systems in all of France's overseas territories and dependencies (French Polynesia, New Caledonia, etc.) and those countries for whose health policy it is responsible (Madagascar, Seychelles, Rodrigue, etc.). Projects concerning medical emergencies in ambulances or during natural and man-made disasters are also being considered as part of ESA's DELTASS initiative (Disaster Emergency Logistic Telemedicine Advanced Satellite System).

- Tele-epidemiology

Tele-epidemiology consists in studying human and animal epidemics, the spread of which is closely tied to environmental factors. By combining vegetation index data from SPOT, meteorological data (winds and cloud masses) from Meteosat, and other Earth observation data from Topex/Poseidon and Envisat (wave height, ocean temperature and colour) with clinical data from humans and animals (clinical cases and serum use) and hydrology data (number and distribution of lakes, water levels in rivers and reservoirs), we can construct predictive mathematical models. A number of such approaches have been tested in the last three years. In Senegal, Rift Valley fever epidemics are being monitored in all risk zones in which the population and cattle are exposed.

In French Guiana, a tele-epidemiology network was set up in mid-2003 to monitor hemorrhagic dengue fever.

As part of the French Ministry of Research's Earth-Space Network, a pilot sentinel network has been deployed in Niger and Burkina-Faso to monitor infectious diseases whose spread is tied to environmental factors.

Today, these projects are operational, operated and funded directly by the users.

Teleconsultation and tele-epidemiology prove that existing resources – satellites, medical kits, infra-

structures and so forth – can be exploited to improve quality of treatment, particularly where environmental conditions are precarious, and achieve significant savings in public health costs. Ground-based data collection and transmission networks supported by satellite imagery can play a vital role in preventing the spread of diseases due to environmental factors. And epidemic monitoring networks can be a first step toward a European health early-warning system, as suggested by the European Commission and voted by the European Parliament.

Keywords: Tele-Epidemiology; Teleconsultation; space-based telemedicine

SYSTEMATIC THINKING IN MULTI-AGENT SYSTEM COORDINATION – APPLIED IN DIABETIC HEALTH CARE

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Multi-agent System (MAS) coordination mainly contains two trends, reductionism and constructionism. Reductionism dominates in a sub-area of MAS called Cooperative Distributed Problem Solving (CDPS). The benevolence assumption is usually considered as a precondition in this area. Agents must comply with the team's interests. The constructionists, on the contrary, concentrate on the individual agents. They consider agents to be self-interested. The team's interest is decided through the MAS coordination, which usually results in the competition among agents.

When we apply MAS coordination to solving a real world problem, for example, in the diabetic health care, neither reductionism nor constructionism is realistic. Diabetic health care system is flexible in the sense that the patients are usually cared distributedly. The care providers (doctors, nurses) possess autonomy to some extent. And they must consider the individual patient that they are taking care of as the most important objective. They cannot make a decision to sacrifice one of their patients to optimize the whole team's interest. Reductionism will lead to a highly organized hierarchy in MAS coordination. Reductionism may optimize the team's interest, but it will lose the flexibility of agents.

If we take the constructionism, we may give much flexibility to agents, but it is easily to lose the control over agents. We obviously cannot let the agents to have full autonomy and do whatever they want. In health care area, this may lead to a disaster. A group of self-interested agents may compete among each other and decrease the efficiency and quality of the diabetic health care.

A good agent should keep a good balance between individual flexibility and team control. Thus, we believe that we need to find a new way of thinking about MAS coordination. In this paper, we adapt Activity Theory to give some systematic thinking to the MAS coordination. The aim is to find out a general mechanism for MAS coordination, which should give the agents autonomy as much as possible, while keep the general maintainability of MAS at the same time. Five factors will be considered for the MAS coordination mechanism: level of cooperation among agents, regulations and protocols, number of agents, type of agents, communication and computation costs.

An agent-based computer system – IMIS – is discussed with the above five factors. IMIS is designed to support the diabetic workers with agent-based services. Three IMIS tasks are: 1) information sharing, 2) organization coordination, 3) task delegation. The IMIS prototype mainly focuses on three levels of agent activities: 1) communication, 2) coordination, 3) collaboration.

Keywords: Diabetes, Multi-agent Systems, Systematic thinking, coordination

TATRC INTERNATIONAL ACTIVITIES

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Since its very start, the Telemedicine and Advanced Technologies Research Center (TATRC) has been involved in the deployment of telemedicine capabilities in different parts of the world.

In recent years, TATRC has diversified its international objectives well beyond providing technological solutions to countries in need. Through its active participation in yearly international professional meetings, the establishment of a West Coast and European presences, along with a continuing effort in developing and nurturing person-to-person relationships, TATRC has now reached a position of world-renowned reference center in the field of advanced technologies applied to health. TATRC's international impact can be seen in three major directions:

1/ Financial support of research projects proposed by foreign scientists,

2/ Organization of a yearly fellowship program for foreign military or civil servants involved in telemedicine programs, and

3/ Coordinate an International Day every year coupled with the American Telemedicine Association annual meeting

Through such efforts, TATRC has now established very strong ties with several countries in all continents. We all have a better understanding about our partners' strengths which will avoid redundancy in our research programs which translates into a waste of resources. Developing this type of close and fruitful relationship with foreign colleagues leads to a much better management of financial resources.

Our presence and our support to Med E Tel is another proof that although we are proud of our achievements, we know that we need to cooperate with our foreign colleagues, so that we all can participate in reaching a common goal: meet the medical challenges in an ever changing world.

Keywords: TATRC, International, International research collaboration

TELECARE – PRACTICAL EXPERIENCES WITH VIDEO COMMUNICATION IN HOMECARE

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Introduction: Ageing societies face the challenge of maintaining a high level of care and fulfilling the requirements of a steadily growing clientele on the one hand as well as keeping the costs of care delivery controllable on the other.

Video Communication can be seen as a supplement to the home visits of nurses and carers. The basis of home care will always be personal contact and presence. Video communication as additive can increase the efficiency of home care whilst increasing the quality at the same time. The client always has immediate and visual access to a medical call centre and the personal security is thereby increased. The hypothesis is that the number of unnecessary home visits will decrease and that the *ad hoc* demand for personal care will slow down as well. For the health care provider it means increased productivity: Growing demand for care can be handled without having to increase manpower.

This presentation will summarize the experiences gained in two independent projects, detailing the process of implementing such video systems, discussing the reasons for success and failure, and provide an outlook on future applications.

Results: Elderly clients accept new technology more easily when it is user-friendly and they are not forced to learn complicated processes of handling the different parts of the video system. The more benefits it offers to the users the greater the acceptance of video communication is. Clients report that they feel more secure in the knowledge that they have permanent direct access to a nurse through a video connection.

Discussion: Whereas the benefits for care providers and nurses were evident, they varied with regards to the elderly patients. Not only technological issues, but also psychological reservations played an important role. In some cases video communication is being seen as a confession to social isolation. In other cases the patient would only accept the technology when instructed by his/her trusted nurse.

Conclusions: Video technology, once adapted to the elderly patient's needs, does not necessarily represent a hurdle. Its acceptance does very much depend on how carefully the user is guided by his/her care provider and on his/her environment (family, friends) motivating him/her to make use of the system. Offering additional benefits such as purchase and delivery services, training videos, physiotherapy group sessions, reminders etc. has a positive effect on familiarising the patient with this new kind of communication.

Future applications: Combining video communication with data acquisition will be a further step towards Telecare, offering new services for patients, for example 24-hour vital-signs-monitoring. Implementing medical devices such as blood pressure monitors, blood glucose monitors, Bluetooth electrocardiogram (ECG) belts, etc. will improve the lives of patients with chronic diseases. Application areas are especially chronic obstructive pulmonary diseases (COPD), congestive heart failure (CHF) and diabetes.

Keywords: Telecare, Video Communication, Homecare, Vital Signs Monitoring

TELECARE IN SINGAPORE HEALTH SERVICES

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This paper describes and discusses Home Telecare initiatives in Singapore Health Services (SingHealth). The outpatients with chronic diseases using the system are:

- Chronic heart failure patients and heart transplant patients
- Pregnant patients with gestational hypertension
- Pregnant patients with diabetes
- Peritoneal Dialysis Patients

The Telecare system provides timely and personalised outpatient care anytime, anywhere by empowering outpatients outside of SingHealth medical facilities to use ubiquitous technologies such as low-cost health monitors and Internet Telecare portal or mobile phone text messages (SMS) to update their daily health status for SingHealth clinicians to review and intervene (if necessary) to reduce complications/emergencies. By using the system, clinicians are also able to actively finetune the medication of their outpatients depending on their recent health status. The system also assists clinicians to extend their reach and care to overseas patients, and traveling patients (who are not able to attend regular reviews in person).

The system empowers clinicians to customise and individually set vital signs thresholds and symptom questionnaire for each of their patients. When a patient's vital signs are abnormal, their clinicians are alerted via SMS. Clinicians can also view a patient's health progress through interactive informative charts. The Telecare portal also provides a secure messaging module for the patient and clinician to communicate with each other. For urgent messages, clinicians can SMS the patient immediately through the portal.

The system is developed in-house using Microsoft.NET with a scalable object-oriented design. Infrastructure/application security features and audit trails have also been implemented to protect patient's privacy and data. The system can handle patients with comorbidities (more than one chronic disease).

Telecare is a possible long-term solution to use information technology to provide long-term care for the rapidly aging population and the rise of chronic degenerative diseases.

Singapore Health Services (SingHealth) consists of a cluster of 3 Hospitals, 5 National Specialist Centers and a network of primary healthcare clinics (polyclinics) distributed around the east side of Singapore providing public healthcare. Each year, SingHealth attends to 3 million patients.

Keywords: Singapore, Telecare, chronic disease, remote monitoring

TELE-EDUCATION IN RUSSIA: SUPPORT REFORM AND DEVELOPMENT OF THE HEALTH DELIVERY SYSTEM

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The Russian Federation is in transition period to international principles of health care delivery shifting the focus to primary health care (PHC). Strengthening PHC requires qualified medical staff including general practice doctors and nurses. Training of medical staff should be based on long-term planning and result from strategic needs. In this respect, the scientifically-justified method of determination of long-term needs of the health sector in staff will be developed and implemented.

We are sure that our real experience in tele-education applications with majority of Russian regions (towns and villages, maximum distance – 12.000 km) will be a good support for PHC Federal Program in training and retraining of health personnel. By now we have three levels All-Russian videoconference network with more than sixty telemedicine points in rural and remote districts of the country. Each telemedicine point usually is placed in regional or district hospital and has the art video conferencing system and ISDN or IP channels (or both) and sometimes Space Satellite channel. We suppose that telemedicine points in district hospitals (third level of network) will be the base for organi-

zation tele-educational support for doctors of general practice and the nurses.

Advantages of tele-education: saving of money, possibility of working with a number of telemedicine points in the same time, chance to attract unique scientists for the tele-education, way to show unique operations and methods of diagnosis, combination of lecture and clinical discussion, the process of training doesn't interrupt the work general practice doctors and nurses in their Health Center in Russia's rural and remote villages and will save a lot of money (very frequently such doctor is all alone in a large district).

It should be noted that the basis for the development of tele-education throughout the rural and remote districts of the country is the understanding of economic efficiency of information technologies for cutting the costs associated with training process of each doctor. Our research has shown that tele-education's centers are economically feasible. The main result of the research was the fact that telemedicine education and consultations centers in small cities and villages are a good return on small investments. For the local population such a centre provides an access to the world leading specialists, while the expenses of the individuals needing such studies and individual consultations are significantly lower than the ones they have to incur for travelling to a training center or clinic. Our colleagues from the Central Syberia assert that, each telelection for specialist from remote village is forty times cheaper than the same one in regional training center.

Our experience shows that new multi-points videoconference information technologies open for us modern ways for professional contacts: teleschools, teleseminars, telesymposiums.

This is very important when physicians' Health Center in Russia's rural and remote village gets new modern diagnostic units (for example: Digital stethoscope, Blood Pressure Measuring Device, Weight Meter, Glucose Meter, Blood Oxygen Saturation Level (SpO2) and Respiratory Flow Meter up to ElectrocardioMeters, EchocardioMeters, Ultrasound digital equipment and so on) – in any case tele-training is only way for quick installation and makes physician familiar with it.

Keywords: telemedicine network, remote regions, interactive tele-training, PHC.

TELEHEALTH MODEL BETWEEN UNIVERSITY AND PRIMARY CARE

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The development of a telehealth model for family health teams and primary care attention came from the necessity of solving two big problems of Brazilian Health Care System, which are: the insufficient number of physicians prepared to deal with primary care, and the difficult access to the second and the third levels of health attention.

Considering the lack of budget to supply health costs, a telehealth model to municipal health system should be planned in such way that it turns out simple, cost efficient, and able to support the family health team in their daily work. Besides it must comply with the ethical rules that the health professions stand up for and, finally, easily adapted to different health organizations and regional cultures.

A telehealth model created with such characteristics is currently funded by the @LIS Project of European Commission and the Brazilian Ministry of Health. It connects the Federal University of Minas Gerais (UFMG) to the Municipal Administration of Belo Horizonte (PBH). A telehealth network was implanted first in Belo Horizonte, and currently extends to other cities in Minas Gerais state, linking the university to inland health centers. The main telehealth activities are permanent education and second opinion in clinical cases, focused on primary care professionals from medicine, nursing and odontology.

The assisting support is based on spontaneous demand, using online technology for complex cases and offline for simple ones. The educational support is provided through teleconferences according to professional necessities. A simple model of technology is used, based on computers with webcams, management and communication software packages, allowing simultaneous online access of multiple basic health units with image, voice and text interaction.

This telehealth model is being gradually implanted, and is now 20 months old. It currently supports

25 health units, and will be expanded to reach 139 more. During its initial implementation there have been performed 140 telehealth events, as follows: 101 second opinion sessions, 8 case report and discussions, 13 telenursing sessions, 5 teleodontology sessions and 13 national and international videoconferences. All these activities gathered approximately 1,500 health professionals. The preliminary results show that after clinical discussions only 24% of patients needed to be relocated. So the system itself is proving to be effective, low cost and responsive. Moreover, a progressive rise in the amount of professionals prone to participate has been observed.

Keywords: telehealth, permanent education, second opinion

TELEHOMECARE IN PALLIATION STUDY (TIPS): REAL TIME VIDEOCONFERENCING SUPPORT FOR END-OF-LIFE CARE

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Purpose: Evaluation of the impact of home telehealth, for palliative cancer patients and their primary caregivers. The study will focus on utilization of health care services, quality of life, pain and symptom management, and satisfaction with service.

Methods: Newly referred patients to the Temmy Latner centre for palliative care, who meet eligibility criteria, are randomized using a computer generated randomization system in to one of two groups; Standard palliative home care or modified standard palliative home care plus home telehealth. Home telehealth consists of a multidisciplinary team of health care professionals providing care via an internet-based videophone.

Patients and nurses have in home DSL internet connections supporting real time conferencing.

Evaluation is conducted every two weeks for a six-month period, by a research assistant, administering a series of surveys over the regular telephone.

Satisfaction of the professionals involved, with home telehealth will be evaluated.

IT: The set up of secure and robust home telehealth delivered challenges and surprises. Hardware and software exhibited bugs. Provisioning of DSL and telephone services was unpredictable, and integration of all the pieces into a workable operating system was difficult.

Results: Recruitment is now complete. 113 patients and 71 caregivers have been recruited to the study. Patient care and surveys will continue until April 2006.

Integration of new technology in the health care field has many different challenges.

In home telehealth the consequence of even minor technical difficulties can have severe, negative consequence on patient care and perception of quality.

Keywords: Telehealth, homecare, end-of-life care.

TELEMEDICINE AGAINST BIOTERRORISM

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Infections are known as the world's largest killer. They account for more than 13 million deaths a year. Most of these deaths occur in countries with low- and middle financed healthcare. All this becomes worse by the huge increase in migrating of large mass populations over the past decade, because of war, famine and natural tragedies. The careful and watchful attention to infections is necessary to avoid bioterrorism outbreaks.

The present initiative aims creation of the system to prevent and control infections with the help of telemedicine. Its mission is the increasing of healthcare access by assuring a public health professionals workforce that meets the needs of the public. The main goal is the creation of the system which will effectively implement the training of medical personnel to identify and respond to public health crises, including bioterrorism and infectious diseases and comprehensively coordinate public health actions too. The initiative promotes organization of the system for the development of an effective response by the civilian medical com-

munities (public health) to the earliest stages infections widespread and biological attacks through the use of telemedicine possibilities that optimally coordinate efforts between civilian medical responders (public health) at national, regional and international levels. The system will ensure the most comprehensive and cost-effective schema of public health professional's activity. The objectives are:

1. Building of structure for effective emergency operations;
2. Developing an infectious-disease mentorship structure, in which the knowledge of outstanding and experienced specialists and international organizations will become direct resource for rural and regional medical providers through application of telemedicine possibilities;
3. Set up and creation of Virtual Department of Public Health for the aim to create the most effective and useful system;
4. Develop and improve existing telemedicine infrastructure.

Keywords: Infections, Bioterrorism, Telemedicine, Public Health

TELEMEDICINE APPLICATIONS IN MOBILE SURGERY

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Background: Mobile Surgery is an innovative way to deliver high quality surgical services to underserved regions of Ecuador. The system has proven to be safe, with a low complication rate, and cost-effective. The sizeable geographic area it covers as well as the remote and rural environment create a challenge for pre-operative and post-operative care. The use of telemedicine applications however may eliminate the long distance intricacies in patient selection, on-site organization, and patient follow-up, and intra-operative consultation if necessary.

Methods: Several systems of establishing telemedicine connectivity between 2 points have been completed. These include plain old telephone lines, dial-up Internet connections for real-time consultation and store-and-forward images, ISDN and satellite connectivity. Two laptop computers and a desktop have been utilized as hardware; and occasionally a RDTU (rapidly deployable telemedicine unit).

Results: In the pre-operative phase we have applied telemedicine for consultation and patient selection. It has decreased the pre-operative time during the remote visit, thus translating into more operating room time. During the intra-operative period we have conducted several projects: Teleanesthesia: to monitor events from a remote location, including the intubation phase, and vital signs throughout the case. Telementoring: where a surgical resident safely complete a laparoscopic cholecystectomy in the jungle of Ecuador under the guidance of a laparoscopic surgeon in the U.S. Telepresence: consultants at a remote location identified anatomical landmarks and participated in surgical decisions in real time. Teleconsultation: in a pediatric urological case providing a specific level of expertise. Finally, in the post-operative period to conduct patient follow-ups at a distance, assessing the surgical wounds for signs of potential complications.

Conclusions: Telemedicine has rendered our program more effective in patient selection; anticipation of medical supplies needed for surgical missions, and decreasing time spent in pre-operative planning at remote locations. Telemedicine also allows us to maintain reliable postoperative surveillance of our patients until their complete recovery and convalescence, overcoming one of the main constraints of intermittent mobile surgery services. It is also an invaluable aid in areas of our country, and perhaps remote areas around the globe where patients have limited access to an experienced surgical team.

Keywords: Mobile Surgery, Telemedicine, Telepresence, and Telementoring.

TELEMEDICINE AS A NEW TOOL IN EMERGENCY MEDICAL SYSTEM OF UZBEKISTAN

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Aim: The purpose of this paper is to study current situation, existing problems and the ways of problems solving in development of telemedicine in main referral hospital – Republican Research

Center of Emergency Medicine (RRCEM) as one of the telehealth model on the territory of former Soviet Union country.

Material and methods: The main decrees of the President of Uzbekistan and the Cabinet of Ministers of Uzbekistan related to development of informational technologies in the country and especially the situation in telehealth's technologies implementation in emergency medical system of Uzbekistan were analyzed and compared with reality of decrees' and orders' execution. Also, activities of international organizations by introduction of telemedicine in emergency medicine of Uzbekistan were studied and evaluated. To determine the level of computer skills of medical personnel of RRCEM special survey from March 2005 has been conducted and first results obtained. The budget of the hospital for informational technologies development, for sustainability of existing computers with internal net system and budget allocation for implementation of electronic medical recording system has been reviewed.

Results: Approved decrees of the Government of Uzbekistan by implementation and development of informational technologies including telemedicine were appropriate and necessary. Inputs of international organization in telehealth/telemedicine development were sufficient but sustainability has not been foreseen. Due to problems with exact determination of financing resources for telemedicine development slow evolution of informational technologies in health care system has been felt. There are not an appropriate number of medical personnel in RRCEM who do not have elementary computer skills, which also impedes use of electronic communication and telemedical consultation.

Conclusion: State controlling mechanism of decrees by informational technologies development execution and clear resource allocation for this purpose should be determined. Training programs for liquidation of computer illiteracy should be immediately implemented in the RRCEM and in whole emergency medical system of Uzbekistan, which could help to develop teleconsultations between affiliates of the RRCEM throughout of the country and main referral hospital located in the capital even using insufficient amount of computers, instable internet and intranet connections.

Keywords: Uzbekistan, Emergency, Telemedicine, education.

TELEMEDICINE DEPLOYMENT TO OPERATION IRAQI FREEDOM – CURRENT STATUS AND LESSONS LEARNED

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Telemedicine support for forward deployed Army Combat Support Hospitals in Iraq was initiated in 2004. Clinical reach-back consultation for medical specialties included radiology, pathology, dermatology, ophthalmology, infectious disease, pediatrics, nephrology, burn/trauma and dentistry. Teleconsultations was accomplished using satellite connectivity over the non-secure military Internet network using both e-mail with JPEG image attachments and DICOM server file transfers. As of December 2005, over 1100 non-radiology consults were completed. Radiology image transfers exceeded 10,000 and include intra- and inter-facility file transfers (to the referring medical facility in Germany). Measures of clinical effectiveness included the number of avoided aeromedical evacuations, decreased lost duty time, and intra-theater medical management of complex cases which improved access to sub-specialty care. Deployment problems encountered included frequent interruption of electrical power, initial bandwidth constraints, and network reconfiguration delaying initial implementation of teleradiology. A follow-on deployment to sites in Kuwait and Afghanistan for tele-radiology was completed in January 2005.

Keywords: TATRC, Telemedicine, Operational Medicine, Lessons Learned, U.S. Military Operations

TELEMEDICINE DEVELOPMENTS: A REGIONAL CONSORTED ACTION IN THE INTERREG IIIC PROGRAMME

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Many cities in Europe are confronted with an increasing health care demand because of an ageing population and an increasing number of people with chronic diseases. The pressure of this increasing demand will be put foremost on primary health care and medical services such as general practitioners, home care services, social assistants, hospitals et cetera. These developments will increasingly have consequences on the needs for health and medical services to be provided as well as for the planning of these services, particularly in urban areas. New technological solutions will provide patients with a number of tools that lead to better self management and a greater awareness of their health condition. Proven modern disease management tools eventually will lead to improved quality of care, a reduction of hospital admissions and therefore a substantial reduction of costs. To start dealing with these problems, one of the aspects that now has been broadly accepted is the use of IT (Information Technology) in health care. In order to accelerate and co-ordinate telemedicine developments on a small and regional level in Europe, several regions have combined their expertise in the INTERREG IIIC Tele Medicine Project. The most important task of this INTERREG IIIC Tele Medicine Project is to establish a seamless and secure exchange of patient data between authorised health care providers and patients, using technical communication standards. Additionally there will be an international platform for exchanging knowledge. The use of IT in health care is gradually expanding and applications, which support the exchange of patient data in the continuum of care, become more and more available. The overall objective of the INTERREGIIIC Tele Medicine project is to explore the effects and opportunities for the local planning of health and medical services and housing facilities in urban areas via the stimulation of more efficient and innovative ICT (wireless) based solutions for domestic health and medical care. The working definition of the Tele Medicine project is as follows: Tele Medicine is the use of information and communication technology in the primary process (first and secondary line care) to improve health services (like cost reduction, shorter waiting lists) and self-management (like better quality of life). Results will effect health and urban planning (policy making). New technological solutions will provide patients with a number of tools that lead to better self-management and a greater awareness of their health condition.

Proven modern disease management tools eventually will lead to improved quality of care, a reduction of hospital admissions and therefore a substantial reduction of costs.

A first step in this exchange of information was providing information about the following subjects:

- The national and regional health care systems;
- The amount of patients with COPD (Chronic Obstructive Pulmonary Diseases); CHF (Congestive Heart Failure) and diabetes
- Regional experiences with telemedicine applications.

The article will address the findings so far, the choice for solutions in pilots, set up and objectives of the pilots.

Keywords: European regional collaboration, telemedicine, chronic diseases, urban planning

TELEMEDICINE FOR INFECTIONS CONTROL

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The application of info-communication technologies for medical purposes stipulated creation of the new field, telemedicine. Through its technological possibilities distance consultations and lectures became reality. Telemedicine is successfully implementing in cardiology, traumatology, emergency, oncology, dermatology and etc., but taking into account its possibilities telemedicine can be effectively used for infections diagnostical, treatment and control purposes. In particular, for trainings of medical personnel, epidemiology, information monitoring, databases organization, creation and update of informational web-pages, contact with world organizations and infected countries for the aim to realize exchange of epidemiology, virology and pharmacology data, for fast communication in healthcare system and also for public education purposes.

In Georgia began creation of the system for infections control by application of telemedicine. The initiative purposes realization of three directions:

1. Creation of the Virtual System of Public Health – for systematic implementation, coordination and monitoring of infections diagnostic, treatment and control, training of medical personnel and public education. For fast, adequate and targeted revealing, diagnostic and control of infec-

tions mentioned system will implement teleconsultations and eLearning methodologies.

2. eLearning – for training of medical personnel and public education Virtual System of Public Health will work out and realize educational programs in accordance with international standards and cycles of popular lectures through distance education technologies.
3. Creation of Medical Information System – for the aim of creation of unified database and improvement of statistical data.

The present initiative means creation of the system the main advantage and peculiarity of which will be combining of public health and telemedicine possibilities.

Keywords: Telemedicine, eLearning, Virtual System of Public Health, Medical Information System

TELEMEDICINE SEGMENT OF THE CROATIAN E-HEALTH SYSTEM

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Main goal and objective: promotes regional cooperation, assists in pre-planning for present/future TelMED (telemedicine) coalitions; service to remote locations, contribute to, and operate with NATO forces, become respectable partner with other partners, "to improve dialogue with local partners in issues and scenarios related to military emergency medicine, developing of the modern telehealth of the 21st century, emergency planning"

Benefits: "telepresence" of the worldvide well known authorities in any MC of the Adriatic region/south-east Europe, emergency planning, intervention and momentary consultation/throughout 24 hrs in remote MCs, protection, successful emergency response, application of the latest technologies are closely followed and implemented in the health/telehealth care of both domicile population and foreign guests, supervision of TeleMED activities will be performed nationally, international agreements of the supervision should be developed and the possible need for international registration of doctors practicing TeleMED internationally shall be evaluated/developed.

In subsequent phases, the cost-effectiveness of a dedicated video server should be considered in order to archive high quality medical images and video clips. This will form a sophisticated and efficient database of medical records that could prove highly useful. The possibility of using this video server for educative purposes of both medical students and professionals should be seriously considered.

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Keywords: telemedicine, e-health, medical images, medical record

TELEMEDICINE STANDARDIZATION – THE NEED FOR AN OPERATIONAL APPROACH

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For the expansion of multinational telemedicine operations, a sine qua non which has been well demonstrated is that of standardization. There are many agencies and organizations working in the realm of technical and communications standards, but few are working in the arena of operational standards. NATO is one exception, and its recent success in establishing a Standardisation Agreement (STANAG) on the development of Teleconsultation systems may be held up as an example for emulation. Recent NATO military operations have demon-

strated both a need for and a lack of interoperability in the area of Telemedicine. Since multinational operations seem to be the wave of the future, and multinational medical support will be mandatory for provision of best care to the patients, NATO has developed an interest in the area of the provision of Teleconsultation across national boundaries. Work in this arena has been carried out by the NATO Telemedicine Panel, and this presentation will discuss the approach of the Telemedicine Panel to standardise and improve multinational Telemedicine support to military operations. The Panel has chosen for practical reasons to concentrate its efforts on Teleconsultation rather than on the broader definitions of Telemedicine, which include patient education, home health care, and monitoring for patients with chronic diseases, due to the fact that these broader areas are not within the purview of NATO, being strictly national responsibilities. The emphasis of the Panel is on Business Processes, rather than technical or clinical standards, and the rationale for this decision will be discussed.

Keywords: TATRC, International, NATO, Standardisation, Business Processes

TELEMEDICINE WORKSTATION FOR DEVELOPING COUNTRIES

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In South Africa there are huge disparities in the availability and delivery of health care services. Health professionals, as well as those in other disciplines, are seeking innovative ways to address the challenge of these inequalities, effectively. Telemedicine, which aims to provide health care across a distance, is an innovative technology, already employed in a number of countries. However, most international telemedicine equipment is totally unsuitable for most healthcare situations in South Africa, associated with the public sector. The shortcomings include lack of robustness, user friendliness, efficient workflow integration and remote maintenance & also inappropriate and insufficient training is available.

The primary health care telemedicine workstation has been developed for specific target market (developing countries whose focus is on primary health care) since most of the focus of telehealth across the globe is in telecare and telemedicine in hospitals. These applications require sophisticated infrastructure and does not always serve those in real need in a developing country. The innovations of this project included no operating system, familiar consumer type interface use, clinical adapted information capturing and differential symptom description system.

The workstation will transfer information communication technology skills to the rural communities and improve South Africa's global competitiveness. The Workstation will be suitable for deployment in a Telemedicine network in the rest of Africa and other developing countries and serve as a viable tool for rural Primary Healthcare, education, social and economic development. In addition it will be an affordable Telemedicine workstation and sustainable Telemedicine networks across Africa.

Keywords: Primary Health Care, Developing Countries, Telemedicine, Innovation

TELE-VIRTUAL REALITY AND TELE-3D-COMPUTER ASSISTED SURGERY IN CROATIA: THE NEWEST TELEMEDICINE TECHNOLOGIES OF THE 21ST CENTURY

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Objectives: During 3D-CAS as well as Tele-3D-CAS (computer assisted surgery), the computer with its operative field image allows the surgeon, by means of up-to-date technologies, to connect the operative instrumentarium to spatial digitalizers connected to the computer. Upon the completion of the tele-operation, the surgeon compares the preoperative and postoperative images and models of the operative field, and studies video records of the procedure itself (www.mef.hr/3D-CFESS).

Methods: The surgeon and consultants use software for CT image previews and 3D-model manipulations on top of collaboration tools to define the pathology, to produce an optimal path to the pathology and to decide how to perform the real

surgery. Using tele-fly-through or tele-VE through 3D-models, both surgeons can preview all the characteristics of the region, and so predict and determine the next steps of the operation (*www.mef.hr/warwounds*).

Results: We used several standards to encode live video signals in telesurgery, such as M-JPEG, MPEG1, MPEG2 and MPEG4. It has been definitely concluded that MPEG4 streams, without audio, have the best picture quality for the operating field/endo camera. For conferencing/consultation cameras used between two or more connected sites during the surgery, we used JPEG and MPEG1 stream with audio. ORs were connected using several computer network technologies with different bandwidths, from T1, E1 and multiple E1 to ATM-OC3 (from 1Mb/s to 155Mb/s). For computer communications using X-protocol for image/3D-models manipulations, we needed an additional 4Mb/s of bandwidth, instead of the 1Mb/s when we used our own communication tools for the transfer of surgical instrument movements. The final step of this project is to create an extremely large uncompressed database (2x47 TB), where all multimedia content will be saved into a massive database with a maximum resolution, and in a format not depending on a resolution. In a case when this is impossible, e.g. with video content (movies), then the compression is as small as possible so that the content is able to maintain the highest quality accessible. For instance, audio data are saved on media for data in a linear format, without any loss in quality (www.mef.hr/orbit).

Conclusions: Using intraoperative records, animated images of the real tele-procedure performed can be designed. Beside otorhinolaryngology, this has also been used in other fields. The more so, in addition to educational applications, VS offers the possibility of preoperative planning in sinus surgery, and has become a very important segment in surgical training and planning of each individual surgical or telesurgical intervention, not only in the reigon of paranasal sinuses. Our tele-3Dsurgery allows surgeons not only to see and to transfer video signals, but also to transfer 3D computer models and surgical instrument movements with image/3D-model manipulations, in real time during the surgery

(*www.mef.hr/MODERNRHINOLOGY*).

Keywords: Tele-virtual reality, Tele-3D-surgery

THE BACKGROUND ON THE MOBILE TELEMEDICINE UNITS APPLICATION IN TELEMEDICINE SERVICES AND NETWORKS WITHIN THE OUTLYING REGIONS

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Many situations arise where a basic medical examination of a subject is desired, but where medical personnel are not always available. Some examples are the following:

Medically Under-served Areas. The number of fully staffed and equipped medical clinics in the world is relatively small, compared to the population and geographic area to be served. Frequently, a medical examination of a distant patient is desirable.

Emergency and Occupational Medicine. Industrial mishaps and natural disasters sometimes occur at locations where medical facilities are not available. Further, even if such a facility is nearby, the extent of damage can over-tax this facility and require assistance of a more remote facility.

The most important conditions which should be considered when we introduce telemedicine to the outlying regions are: low population density; extensive transport communications (sea, river, air, motor car); insufficient infrastructure of land communication channels; a high probability of extreme situations and labour injuries; sometimes – heavy climate and weather conditions. Considering the above mentioned peculiarities, we may suggest the following patterns of telemedicine projects for the outlying regions: telemedicine in cities, telemedicine in small and temporary settlements, telemedicine in local regions-enclaves, telemedicine in mobile groups, telemedicine for navigation and off-shore platforms, telemedicine for native population, telemedicine for emergency and disaster relief. These projects don't exhaust all possible approaches to this problem. However, the fact is that the application of stationary telemedicine systems gets impossible or economically unjustified as we move to the outlying places.

The wide Mobile Telemedicine Units (MTU) application is to become one of the specific components of the Russian telemedicine system. The range of MTU markets is determined additionally by expeditionary,

long shift work and other activities in the North, for instance. Here should be considered crews of seacrafts (transport, icebreaking, survey vessels, geological), oil and gas drilling sea platforms. MTU can be used in aerial ambulances and other mobile medical services, by rescuers and forces eliminating consequences of man-caused (including ecological) and natural disasters.

Out task is to develop medical diagnostic unit which contains instruments by which a technician can perform a physical examination of a subject, and the apparatus contains a communication system that transmits results of the examination to a remote location for analysis by medical personnel.

In Russia we have an experience of working with some mobile units and its prototypes. MTU will allow communication and data transmission systems to maintain users' access to consultative telemedicine centers resources and other services of telemedicine systems and networks.

Keywords: Telemedicine, mobile, space

THE CREATION OF A NATIONAL TELEMEDICINE/EHEALTH ASSOCIATION IN NIGERIA AND ITS IMPACT ON THE FEDERAL MINISTRY OF HEALTH ICT- COMMITTEE

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The national telemedicine/ehealth association in Nigeria called the Society for Telemedicine and eHealth in Nigeria (SFTeHIN), created April 2005. The association is an organization formed to keep with global trend in healthcare delivery the use of telemedicine and ehealth as a tool to improve healthcare delivery system in Nigeria. Society for Telemedicine and eHealth in Nigeria serve to promote the cause of telemedicine/ehealth in the public and private institution in Nigeria. The society educates government about telemedicine/ehealth as an essential component to the delivery of modern healthcare. The Federal Ministry of Health (FMOH) inaugurated its ICT-committee in 2003 charged with the responsibility to deploy ICT facilities for the ministry in other to make information about its activities available and accessible to its workers, other arms of government; its development partners; private sector organizations, the Nigerian public and the world at large. Activities of the society since its creation, which included organizing national stakeholders meeting on developing national telemedicine/ehealth program, first telemedicine/ehealth workshop in Nigeria has led to good working relationship with the government agencies and nominated her as a member of the FMOH's ICT-committee. The committee is committed to working with the society and its partners on how to deploy ICT in the ministry, which include: electronic linkage between FMOH and its hospitals; FMOH e-learning center/ e-library; facilities for telemedicine and human resource development implications of these projects. The national awareness raised by the society on issues of developing ehealth in Nigeria contributed to the decision of the committee, resolved to implement some of this project in the next fiscal year (2006). To complete the computerization of FMOH's administrative and programmatic functions; carry out a country feasibility study of telemedicine in Nigeria with the society in view to facilitate its development in the country. One of the components of the Health Sector Performance issues addressed by the Health Sector Reform Program is improving the stewardship role of government by deploying information and communications technologies (ICTs).

Keywords: National ehealth association, Federal Ministry of Health, Health Sector Reform Program, Deploying ICT

THE RELEVANCE OF USER EVALUATION RESEARCH FOR E-HEALTH-APPLICATIONS IN THE HOMECARE SETTING

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Background: Within the broad field of e-health specific attention is being paid to telehomecare applications. In this domain more attention has to be paid on the intertwining of technological design and the contexts of use. In order to optimise an effective and efficient implementation of telehomecare technology the user perspective needs particular attention. Lessons can especially be learned from 'the social construction of technology' literature focussing on the 'technology as an artefact' and 'the social context' in which the technology is embedded and from evaluation research.

Objective: We will demonstrate the importance of User Needs assessment, knowledge and insight in the particularities of the healthcare sector as a critical part of the design and implementation of telehealth applications.

Methods: Experiences in two pilot telehomecare projects in Belgium, demonstrate the added value of user evaluation research. The first project designed and introduced a telemonitoring application (blood pressure and glycaemia) in the homecare sector. The second project is the development of an eHomecare platform supporting the care process of patients in the primary healthcare sector.

Using a constructive technology assessment (CTA) approach the follow-up, development and introduction of the telehomecare applications in the primary healthcare field is being done. The perspectives of the different stakeholders, with their own needs, expectations and values, are studied, evaluated and integrated in an evaluation framework, and taken into account when designing and implementing the technology.

Results: The "institutional field" of healthcare plays an important role in the use and acceptance of telehealth applications. In healthcare, consumer behaviour is to a large degree triggered by the package of reimbursed care (e.g. resistance of future use of telemonitoring applications by diabetes patients because of non-repayment). Specific requirements of homecare applications are identified when doing user needs research (e.g. guaranteeing mobility, usability aspects, particular needs for particular pathologies). Furthermore, user research clearly demonstrates stakeholders values and interests. The existing tension between the medical and paramedical domain can induce resistance from certain users (e.g. general practitioners who refuse interference by homecare nurses in 'their' medical field).

Conclusion: A thorough understanding of the social and healthcare culture and structure is essential for the acceptance, acceptability and feasibility of an application. The healthcare field is characterised by specific financial features, power relations, organisational aspects and needs of different types of users, which partially determines the successes and failures of e-health-systems. These insights and considerations need to be integrated developing and implementing future telehomecare applications.

Keywords: User needs assessment, evaluation research, telehomecare applications

TOWARDS A GLOBAL E-HEALTH FRAMEWORK FOR THE SUPPORT OF PANDEMIC CONTROL

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Recent occurrences of epidemics like the Severe Acute Respiratory Syndrome' (SARS) in 2003 or, the 'Avian Influenza' in 2005 clearly display the threat and seriousness of global diseases. The steadily growing globalization makes it difficult to contain epidemics to a certain region. Hence they are called Pandemics. Furthermore, global disease threats are not limited to natural causes anymore. The possibility of terrorists using biological weapons has become very real. Although many countries are now working on their own security frameworks, a global problem of this magnitude requires a global solution. For these reasons, a global framework must be designed and implemented. This paper reviews the current efforts in evolving a global solution to the problem, and summarizes the basic principles of such a framework for pandemic control.

Three major organizations working on this topic are WHO (*http://www.who.int/*), European Centre for Prevention and Disease Control (ECDC – *http://www.ecdc.eu.int/*) and Centres for Disease Control and Prevention (CDC – *http://www.cdc.gov/*). They have established and maintained numerous networks for different purposes. These organizations and even some of their networks cover several topic areas. There are a number of specialised content and application networks for disease surveillance and control, such as:

1) Surveillance Network:
- Antimicrobial resistance information bank (http://oms2.b3e.jussieu.fr/arinfobank/),
- FluNet and RABNET (*http://gamapserver.who.int/GlobalAtlas/home.asp*),
- Global Salm-Surv (*http://www.who.int/salmsurv/en/*),
- East Asia Network for HIV (EAN-HIV)

2) Community Alert Network:
- Outbreak verification list (*http://www.who.int/disease-outbreak-news/*),
- Weekly Epidemiological Record (*http://www.who.int/wer/*),
- Health Alert Network (*HAN – http://www.phppo.cdc.gov/han/*), USA

– APEC EINET

3) Expert Systems
– US CDC NEDSS

4) (Inter-) National Information Exchange and Communication Network
– Health InterNetwork (H*IN - http://www.health-internetwork.net/*), USA
– WHO GOARN

5) Medical and Biological Research Networks:
– Roland Koch Institute (RKI - http://www.rki.de/), Germany

An important part of the global e-Health framework for pandemic control, however, is to establish an 'Emergency Response Network' (ERM) that is able to handle all occurring diseases, especially unknown ones. This includes the above sub-networks each of which was designed for a different purpose and phase during the outbreak cycle.

The proposed solution for a framework has to be realised both at the national and global levels. While global networks provide information exchange based on certain standard semantics, national level of the framework implements most of the controls. The focus of the international implementation, however, is on information exchange, and it has the following levels:
– Organization/Government Level
– Process Level
– Service/Application Level
– Information and Communication Technology (ICT) Infrastructure Level

This paper discusses the issues at each of the above levels with respect to various stakeholders, barriers and problems for implementation with reference to different phases of a possible outbreak/disaster cycle, e.g.,
– Prevention
– Detection and Verification
– Early Response
– Sustained Response
– Recovery

The presentation will conclude with a demonstration of a geographical information system for Pandemic Surveillance and Control software developed as part of a collaborative effort by the Australian industry and universities.

Keywords: Global e-Health Solutions, Pandemic Control, Interorganisational information networks

TRANSTELEPHONIC ECG, DIFFERENT APPROACHES: THE AEROTEL EXPERIENCE

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Aerotel Medical Systems manufactures and develops Transtelephonic ECG monitors which are supported by its remote receiving software enabling the Diagnosis and the management of the data received from those monitors.

Its clientele is spread out through the World, from the Far East to North America, and have managed through the years to develop different applications and Business models for the same type of monitors, thus making it one of the most flexible and a world leader in cost effectiveness.

This presentation will provide a review of the various Heart monitors and the different approaches that the different users have opted, showing the various business models available in telemedicine.

The presentation will be supported by video examples of various call centres.

Keywords: telemedicine, transtelephonic ECG, remote care, patient monitoring, telecardiology, cardiac monitoring

USER EXPERIENCE DESIGN GUIDELINES FOR TELECARE SERVICES

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This abstract proposes a paper, addressing user experience aspects of telecare services, related challenges and recommended design guidelines, under development in ETSI. The work will be introduced to the Med-e-Tel community and experts will be invited to follow and contribute to the development of the ETSI Guide.

The changing demographics of Europe indicate a development towards a population getting older and living longer than ever. The majority of the dependant population receives informal care, but the population of informal carers is decreasing and aging.

Delivering traditional health care services will lead to an increased cost at a questionable perceived quality, as tomorrow's clients expect freedom of choice, mobility and personal attention on demand [1].

With the technical development offering seamless and more continuous access to fixed and mobile broadband networks, the vision of a world where ICT resources around us improve the quality of our lives becomes realistic. New applications and services are increasingly used to perform necessary tasks and activities of daily living.

Human factors and the user experience of the delivery of health and social care to individuals within the home or a wider community, with the support of systems enabled by ICT (known as telecare services) is a complex area. It involves a large number of influencing elements, including the establishment of human confidence, device setup, configuration, calibration and maintenance, data collection, user procedures, cultural issues such as the use of language and illustrations, the organization of the care provisioning process, and communication with diagnostic systems and carers, human communication and confirmation and decision making, the presentation medium and accessibility issues.

In addition, as telecare services can be used not only in- but also outside of homes, usability aspects relating to the specifics of mobile environments and equipment and service use need to be covered.

Last but not least, these services must be usable to young, older, impaired and disabled people [2]-[3]- and therefore, designed, developed and deployed accordingly!

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[3] CEN/CENELEC Guide 6: "Guidelines for standards developers to address the needs of older persons and persons with disabilities".

Keywords: Telecare, Usability, User experience, Guidelines

VIRTUAL HEALTH CARE KNOWLEDGE CENTER IN GEORGIA

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Several years ago, any talk related to the Internet, would have to be preceded by an explanation of what it is and how it works, but at present eHealth became the essential part of life and practical activity. eHealth is the dissemination of medical information using the digital medium. This field absolutely depends upon Information and Communication Technologies.

eHealth has a great potentiality; however there are unfortunately today few examples of large services. The benefits of expanding its use are threefold: it can improve the quality of healthcare services; it allows a better exploitation of limited hospital resources and of expensive medical equipment; and it helps to address the problem of unequal access to healthcare. Throughout the world the number of people requiring special care is increasing as the proportion of elderly people rises, at the same time, in a high-tech age the expectations of the society for a better healthcare are also rising. eHealth offers the opportunity for improving healthcare service and for making healthcare expertise available to underserved locations.

eHealth is innovation for Georgia. The "Virtual Health Care Knowledge Center in Georgia" project is implementing pilot actions in this field. The project is part of NATO Networking Infrastructure Programme. The main goal of the project "Virtual Health Care Knowledge Center in Georgia" is to prove flexibility, cost effectiveness and organizational impact of eHealth for healthcare organizations by developing a community service useful and profitable in the following fields: remote medical consultations, eLearning, clinical data management, cooperative clinical information management, broadcast of multimedia contents between project participants for teleconsultation and training purposes.

The first year of implementation of "Virtual Health Care Knowledge Center in Georgia" project was focused upon the setup and installation of the server, creation of experts group and realization of remote medical consultations in static mode. After the first year of project's implementation it was revealed, that eHealth is the most important for the ensuring the safe primary medical care in Georgia. The first contact of patients needing medical help is the contact with the local primary care health center. Second opinions from specialists are often required in primary care health centers. (i.e: radiology, cardiology, dermatology, consultations with specialists regarding further treatment of the patient;

is hospitalization needed or not? etc). An efficient and appropriate strategy of medical care can be worked out at the initial steps of patient's contact with health care. Such an approach can avoid unnecessary hospitalization, and will be a substantial contribution to the reduction of health costs.

Keywords: eHealth, eLearning, Remote medical consultations, Teleconsultation

VIRTUAL REALITY FOR BEHAVIORAL HEALTHCARE

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Simulation technology has long been used to train individuals in highly specialized fields. For example, the U.S. Air Force and NASA used simulations to allow pilots and astronauts to practice maneuvers in a safe environment before attempting these complicated tasks in the real world. However, new applications of these technologies are enabling residents to practice surgery without endangering human life, encouraging patients to complete physical therapy without resistance, and allowing individuals to overcome their fears and distorted cognitions in the privacy of their clinician's office.

The applications of simulation technology in health care are numerous. Below is a partial list of the uses that are currently being investigated:

- Treatment of anxiety disorders, including specific phobias, panic disorder, agoraphobia, social phobia, and posttraumatic stress disorder
- Treatment of eating disorders and obesity
- Assessment and treatment of schizophrenia
- Assessment and treatment of attention deficit disorder
- Skills training in autism
- Treatment and Diagnosis of Cognitive Deficits
- Physical Rehabilitation
- Management of chronic pain
- Distraction from pain associated with medical and dental procedures
- Quality of Life in Individuals with Chronic Illnesses
- Empathy
- Stress inoculation training

Simulation technology has allowed clinicians to treat patients more effectively and efficiently, without concerns of excessive cost, loss of confidentiality and limited safety that arise with many conventional treatments. The therapeutic benefits of using simulations are becoming increasingly well recognized and fully supported with results from controlled clinical trials. With more than 1,000 papers already indexed in Medline, it is certain that simulation technology is a strong force in health care.

Throughout the history of development of simulations for health care use, success has depended on a triad made up of clinicians, technicians, and patients working together to create effective simulations. No part of this triad can create a successful application on its own. Thus, it is essential that attendees of this conference are able to learn about the possibilities of computer simulations in health care so that multi-disciplinary teams can be created that will work together to advance the field. This discussion is an important way to bring various experts out of their own corner of the scientific universe to collaborate on projects that will expand options for patients and their care givers.

Keywords: Virtual reality, simulation technology, PTSD, education and training

VISUAL COMMUNICATION FOR HEALTHCARE

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While no currently available technology can completely substitute for the in-person physical examination of an individual patient or specimen, the Visual Communication Technology available today can provide high quality, high resolution long distance images which can bring a significant and valuable tool for physicians and other medical professionals who are unable to examine a patient or specimen in person.

Video has become the number one tool to increase the efficiency of daily routines, administrative, continuative medical training and clinical through interactive, real-time communication.

We will examine with concrete cases how far and reliable is the technology today and what we will expect to see in the near feature.

Keywords: Video communication, Telehealth, Telemedicine

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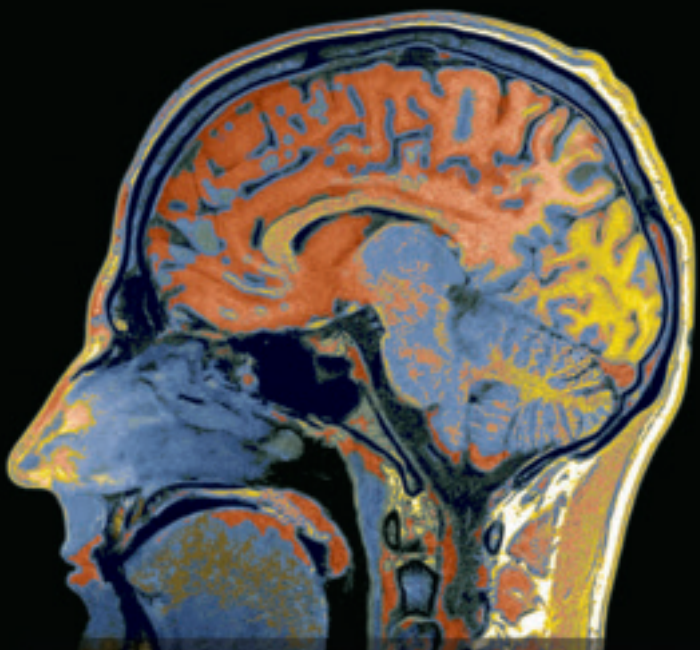

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